
IN THE COMMONWEALTH COURT OF PENNSYLVANIA

	CASES CONSOLIDATED
Carol Ann Carter, <i>et al.</i> , Petitioners	:
	:
	:
v.	: No. 464 M.D. 2021
Leigh Chapman, <i>et al.</i> , Respondents	:
	:
	:
Philip T. Gressman, <i>et al.</i> , Petitioners	:
	:
	:
v.	: No. 465 M.D. 2021
Leigh Chapman, <i>et al.</i> , Respondents	:
	:
	:

**CARTER PETITIONERS' BRIEF IN SUPPORT OF PROPOSED
CONGRESSIONAL REDISTRICTING PLAN**

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Pursuant to this Court’s January 14, 2022 scheduling order, the *Carter* Petitioners hereby submit this brief in support of their 2022 Pennsylvania Congressional Redistricting Plan (the “Carter Plan”).¹

INTRODUCTION

Four years ago, in *League of Women Voters of Pa. v. Commonwealth*, 645 Pa. 576 (2018) (*LWV II*), the Pennsylvania Supreme Court struck down the 2011 congressional map as a partisan gerrymander and adopted a remedial congressional map that reflected the physical and political geography of the Commonwealth (the “2018 Remedial Plan”). The Carter Plan builds on the court-approved 2018 Remedial Plan, preserving the cores and lines of current districts to the greatest extent possible, while accounting for changes in the Commonwealth’s population over the past decade. The Carter Plan meets or surpasses the 2018 Remedial Plan’s performance on the state’s traditional redistricting criteria while also reflecting the partisan preferences of Pennsylvania voters.

Although metropolitan areas in Pennsylvania experienced population growth at the same rate as the United States as a whole, substantial population decline in rural Pennsylvania entitles Pennsylvania to one fewer congressional district for the next decade. As a result, the *Carter* Petitioners’ proposed districts in Southeastern

¹ The Carter Plan was drawn using 2020 Census redistricting data. The population of each of its districts remains the same whether one uses the 2020 Census redistricting data set or the Legislative Reapportionment Commission’s Data Set #1.

Pennsylvania and the Pittsburgh area change very little from the 2018 Remedial Plan, whereas the loss of a rural district necessitates more changes in the geographic size and configuration of districts in the rest of the state to preserve population equality. Nevertheless, even where district boundary changes were necessary to equalize population, the Carter Plan adjusts those boundaries in ways that matched or improved the 2018 map’s compliance with the traditional, objective redistricting criteria that the Pennsylvania Supreme Court set forth in *LWV I*: compactness, contiguity, equality of population, and respect for the integrity of political subdivisions.

For these reasons, explained in more detail below, the *Carter* Petitioners respectfully ask this Court to adopt the Carter Plan in full.

BACKGROUND

On January 14, 2022, this Court issued an order requesting that all parties in the case submit “at least one (1) but no more than two (2) proposed 17-district congressional redistricting plan(s) that are consistent with the results of the 2020 Census and, if the party chooses to do so, a supporting brief and/or a supporting expert report, by 5:00 p.m. on Monday, January 24, 2022.” Order, *Carter v. Degraffenreid*, Nos. 464 MD 2021, 465 MD 2021 (Pa. Commw. Ct. Jan. 14, 2022).

The Pennsylvania Supreme Court adopted the 2018 Remedial Plan after it invalidated the 2011 plan as a violation of the “Free and Equal” Elections Clause of

the Pennsylvania Constitution. *LWV II*, 645 Pa. 576. During the remedial stage of that litigation, the Pennsylvania Supreme Court identified several “neutral criteria” to assess congressional redistricting plans: (1) population equality; (2) compactness; (3) contiguity; and (4) respect for political subdivisions. *League of Women Voters v. Commonwealth (LWV I)*, 178 A.3d 737, 816–17 (Pa. 2018). The goal was to create “representational districts that both maintain the geographical and social cohesion of the communities in which people live and conduct the majority of their day-to-day affairs, and accord equal weight to the votes of residents in each of the various districts.” *Id.* at 814, 816. In ultimately adopting the 2018 Remedial Plan, the Pennsylvania Supreme Court emphasized that the 2018 Remedial Plan was “superior or comparable” to the other plans before the Court based on the relevant neutral criteria it had identified previously. Opinion and Order Adopting Remedial Plan at 7, *League of Women Voters of Pa. v. Commonwealth*, No. 159 MM 2017 (M.D. Pa. 2018).

Pennsylvania’s 2018 congressional redistricting litigation thus provides recent guidance both on the drawing of a proposed congressional plan and the criteria by which it should be evaluated. The 2018 Remedial Plan was drawn using last decade’s population counts, however. 2020 Census data shows that Pennsylvania is now entitled to one fewer seat due to its slow population growth as compared to the rest of the United States. The challenge for a map drawer, therefore, is drawing a

plan that adheres to the guidance set forth in *LWV I* while grappling with Pennsylvania's population loss. The Carter Plan achieves these goals.

Pursuant to this Court's instructions, the *Carter* Petitioners submit one proposed 17-district map using the 2020 Census redistricting data set, the accompanying expert report of Dr. Jonathan Rodden, and this brief.

THE CARTER PLAN

The Carter Plan is appended to this brief as Exhibit 2. As described below, *see infra* Section I, it implements a least-change approach. Using the 2018 Remedial Map as a starting point, it preserves district cores, creates continuity in representation, and respects communities of interest. It also satisfies the traditional redistricting criteria announced in *LWV I* and other redistricting principles that the Pennsylvania Supreme Court has relied upon in the past.

At the same time, the Carter Plan accounts for the significant changes in Pennsylvania's population between 2011 and 2021. Pennsylvania's population change was not uniform statewide. Rural regions of the state lost population. But urban areas grew—some, significantly. In particular, Chester, Lehigh, and Montgomery Counties in the southeast, as well as Dauphin County in Central Pennsylvania, all grew by over 8 percent. *See* Ex. 1, Rodden Expert Report (hereinafter Ex. 1) at 7. And Allegheny County, encompassing Pittsburgh, grew by 2.2%. *Id.* By contrast, rural counties, like Fayette, lost population. *Id.*

Pennsylvania lost a congressional district because its population did not grow as much as other states'. This slower growth is attributable largely to population decline outside of Pennsylvania's metropolitan areas. *Id.* at 7. Consequently, although the districts in metropolitan areas need only be fine-tuned based on local variation in the rate of population growth, more significant changes to existing districts in rural Pennsylvania are unavoidable. *Id.* at 9. The Carter Plan makes these adjustments in a manner that aligns with the redistricting principles outlined below.

REDISTRICTING PRINCIPLES

I. Least-Change Approach

Because the Pennsylvania Supreme Court adopted a congressional districting plan that it found to be “superior or comparable” to any plan submitted by parties and amici in the *LWV* case just four years ago, the *Carter* Petitioners took a “least-change” approach to drawing their proposed map. As such, they used the 2018 Remedial Plan as a starting point, a common strategy courts deploy when, as here, the existing map is rendered obsolete by population changes. *LaComb v. Growe*, 541 F. Supp. 154, 151 (D. Minn. 1982) (stating that the “starting point” for new, court-drawn congressional districts is the last configuration of districts); *see also* Order, *Johnson v. WEC*, No. 2021AP1450-OA, ¶ 81 (plurality op.), ¶ 87 (Hagedorn, J., concurring) (Wis. Nov. 30, 2021) (holding that judicially adopted plans should attempt to minimize changes from the previous map); Order, *Hippert v. Ritchie*, 813

N.W. 2d 374, 380 (Minn. 2012), No. A11-152 (Minn. Special Redistricting Panel Feb. 21, 2012) (explaining that the judicial redistricting panel “utilizes a least-change strategy where feasible”).

By taking this approach, the *Carter* Petitioners were able to preserve the core of the 2018 Remedial Plan’s districts and create continuity for the overwhelming majority of Pennsylvania residents. *See Karcher v. Daggett*, 462 U.S. 725, 740 (1983) (recognizing that preserving district cores is a traditional principle of redistricting); *Reynolds v. Sims*, 377 U.S. 533, 578-79 (1964) (same). Under the Carter Plan, 87 percent of Pennsylvania’s population would remain in their 2018 Remedial Plan district. *See* Ex. 1 at 20. Moreover, the Carter Plan’s least-change approach required no sacrifice of any of the traditional redistricting criteria outlined by the Pennsylvania Supreme Court; it meets or surpasses the 2018 Remedial Plan on population equality, compactness, contiguity, and political subdivision splits.

II. Traditional Redistricting Criteria Announced in *LWV*

The Carter Plan meets or surpasses the 2018 Remedial Plan on the *LWV I* court’s redistricting criteria while also reflecting the partisan preferences of Pennsylvania voters.

a. Equal Population

The Carter Plan satisfies the requirement for equal population. A congressional redistricting plan “should consist of congressional districts . . . as

nearly equal in population as practicable.” *LWV II*, 645 Pa. at 581. Under the “one person, one vote” principle, congressional districts within a state must have equally apportioned numbers of persons. *See Wesberry v. Sanders*, 376 U.S. 1, 7-8 (1964). For federal congressional districts, the United States Constitution “permits only the limited population variances which are unavoidable despite a good-faith effort to achieve absolute equality.” *Kirkpatrick v. Preisler*, 394 U.S. 526, 531 (1969); *see also Mellow v. Mitchell*, 530 Pa. 44, 51 (1992).

The Carter Plan satisfies this principle. The ideal population of the 17 congressional districts is 764,865. The Carter Plan includes 4 districts with the ideal population and 13 districts with a deviation of plus or minus one person. This level of population deviation readily satisfies constitutional requirements. *Colleton Cty. Council v. McConnell*, 201 F. Supp. 2d 618, 664 (D.S.C. 2002) (“In keeping with our overriding concern, the court plan complies with the ‘as nearly as practicable’ population equality requirement of Article 1, § 2 of the Constitution, with a deviation of plus or minus one person.” (citing *Karcher*, 462 U.S. at 730)).

b. Compactness

The Carter Plan is comparable in compactness to the 2018 Remedial Plan. Ex. 1 at 22-23.

A congressional redistricting plan “should consist of congressional districts composed of compact . . . territory.” *LWV II*, 645 Pa. at 581; *see also Miller v. Johnson*, 515 U.S. 900, 916 (1995); *Brown v. Thomson*, 462 U.S. 835, 842 (1983).

The Carter Plan satisfies this principle. *See* Ex. 1 at 22-23. Consistent with the *LWV I* decision, the *Carter* Petitioners have reported the results of the Reock, Schwartzberg, Polsby-Popper, Population Polygon, and Area/Convex Hull measures of compactness for each district.² *See* Ex. 1 at 22, Table 5; *see also League of Women Voters v. Commonwealth*, 645 Pa. 1, 46-48 (2018) (calling the Reock and Polsby-Popper metrics “widely-accepted standards”). Overall, the Carter Plan’s Reock score matches the 2018 Remedial Plan’s score; its Schwartzberg score is better than the 2018 Remedial Plan’s score; and it falls just shy of matching (each by 0.01) the 2018 Remedial Plan’s scores on the remaining measures. The Carter Plan’s slight decrease along some compactness measures results from the effort to maintain population

² The Reock test compares each district to an ideal circle and computes the ratio of the area of the district to the minimum area of a circle sufficiently large to encompass the district. The Schwartzberg test is similar, taking the ratio of the perimeter of a district to the circumference of a circle whose area is equal to the area of the district. The Polsby-Popper test compares the ratio of a district’s area with the area of a circle sharing the same perimeter. The Population Polygon test computes the ratio of a district’s population to the population of the minimum convex polygon that completely contains the district. And the Area/Convex Hull test measures the ratio of a district’s area to the area of the minimum convex shape that completely contains the district. The numerical result of each test falls between zero and one, with one being the most compact.

equality in Districts 4 and 5. Population deviations in the counties comprising these districts—specifically Bucks and Delaware Counties—required the Carter Plan to reach outside of those subdivisions for additional population.³

c. Contiguity

The Carter Plan’s districts are contiguous. A congressional redistricting plan “should consist of congressional districts composed of . . . contiguous territory.” *LWV II*, 645 Pa. at 581; *see also Miller*, 515 U.S. at 916. Each of the Carter Plan’s 17 districts is contiguous and includes none of the “isthmuses” or “tentacles” that concerned the Supreme Court in *League of Women Voters of Pa. v. Commonwealth*. *LWV I*, 645 Pa. at 126.

d. Integrity of Political Subdivisions

Finally, the Carter Plan maintains and builds upon the 2018 Remedial Plan’s respect for the integrity of political subdivisions. A congressional redistricting plan “should consist of congressional districts . . . which do not divide any county, city, incorporated town, borough, township, or ward, except where necessary to ensure

³ In particular, Dr. Rodden explains that in drawing the Carter Plan, he had to make a choice between drawing less compact districts centered on Bucks and Delaware Counties by including population tracts in neighboring Montgomery County or disrupting the 2018 Remedial Plan’s careful efforts not to split Chester, Lancaster, Lehigh, and Northampton Counties. *See Ex. 1 at 8*. Ultimately, the Carter Plan does the former.

equality of population.” *LWV II*, 645 Pa. at 581; *see also Karcher*, 462 U.S. at 740–41; *Reynolds*, 377 U.S. at 580–81.

The Carter Plan satisfies this principle. *See* Ex. 1 at 21. In comparison to the 2018 Remedial Plan, which the Pennsylvania Supreme Court chose in part because it performed well on this score, the Carter Plan has the same or fewer county, county subdivision, and vote tabulation district splits. *Id.*

III. Other Redistricting Principles

The Carter Plan also embodies other redistricting principles considered by the Pennsylvania Supreme Court. It preserves minority voting rights, maintains communities of interest, and reflects Pennsylvanians’ partisan preferences.

a. Minority Voting Rights

The Carter Plan maintains the protection for minority voting rights reflected in the 2018 Remedial Plan. In *Mellow v. Mitchell*, the Pennsylvania Supreme Court adopted the Commonwealth Court’s recommendation to approve a congressional redistricting plan in part because that plan achieved greater minority representation.

Mellow v. Mitchell, 530 Pa. 44, 50 (1992). Likewise, under federal law, districts must be drawn to protect the equal opportunity of racial, ethnic, and language minorities to participate in the political process and elect candidates of their choice, whether alone or in alliance with others. Voting Rights Act of 1965, 52 U.S.C. § 10301(b) (2018). And districts must not be drawn with either the purpose or effect of

denying or abridging the voting rights of any United States citizen on account of race, ethnicity, or membership in a language minority group. U.S. Const. amends. XIV, XV; 52 U.S.C. § 10301(a).

The Carter Plan satisfies this principle. It closely follows the boundaries of the 2018 Remedial Plan with regard to those areas of the state with sizeable minority populations, thus preserving the minority opportunity districts that the Pennsylvania Supreme Court approved in 2018. Moreover, Dr. Rodden did not take racial data into account when making adjustments for population changes. *See* Ex. 1 at 23.

b. Communities of Interest

The *Mellow* Court adopted a congressional redistricting plan that implemented “community-of-interest factors in those regions of the State which have identified them.” *Mellow*, 530 Pa. at 50; *see also Ala. Legis. Black Caucus v. Alabama*, 575 U.S. 254, 272 (2015) (describing respect for “communities defined by actual shared interests” as a traditional redistricting principle (quotation omitted)). Likewise, the Governor’s Pennsylvania Redistricting Advisory Council adopted “communities of interest” as one of its redistricting principles, defining the term as “contiguous geographic areas or neighborhoods in which residents share common socio-economic and cultural interests which the residents of the region may seek to translate into effective representation. Examples of shared interests include those common to rural, urban, industrial or agricultural areas, where residents have

similar work opportunities, share similar standards of living, use the same transportation facilities, or share common environmental, healthcare, or educational concerns, among others.” Advisory Council Redistricting Principles, available at <https://www.governor.pa.gov/wp-content/uploads/2021/11/Redistricting-Advisory-Council-Final-Principles.pdf>.

The Carter Plan satisfies this principle. In applying a least-change approach and focusing on the Pennsylvania Supreme Court’s traditional redistricting criteria, the Carter Plan creates districts that represent natural and well-defined communities of interest. As described above, the current districts were crafted by a Court-appointed advisor who considered a lengthy Commonwealth Court record and many submissions by parties and amici. For those changes that the Carter Plan does make, it follows natural and political subdivision boundaries with a focus on keeping communities together. For example, when District 7 required additional population, Dr. Rodden added Carbon County to unify the Allentown-Bethlehem-Easton metropolitan statistical area consisting of the entirety of Northampton, Lehigh, and Carbon Counties. Ex. 1 at 13-14, Figure 6. Likewise, the new District 15, which had to change significantly due to population changes and the loss of what is District 12 under the 2018 Remedial Plan, now avoids a split of Centre County that had previously separated State College from some of its suburbs. *Id.* at 18, Figure 10.

c. Partisan Fairness

Finally, the Carter Plan reflects the partisan preferences of Pennsylvania voters. In *Mellow*, the Pennsylvania Supreme Court cited partisan fairness—the fact that the map in question resulted in a “politically fair balance in the Pennsylvania delegation between Democrats and Republicans”—as an additional factor to support adoption of the Commonwealth Court’s recommendation. *Mellow*, 530 Pa. at 58. Similarly, the Pennsylvania Redistricting Advisory Council adopted both “partisan fairness” and “competitiveness and responsiveness” as favored principles. The Council defined “partisan fairness” as “requir[ing] that parties have the opportunity to translate their popular support into legislative representation with approximately equal efficiency such that the proportion of districts whose voters favor each political party should correlate to the statewide preferences of the voters.” It defined a “competitive district [as] one in which the electoral outcome is close enough that the district can change with shifting voter preferences” and a “responsive map [as] one with enough competitive districts to allow for changes in the composition of the delegation with changes in proportion of votes for the parties.” *Id.*

The Carter Plan satisfies these principles. Although Dr. Rodden did not consider partisan outcomes when drawing his map, he later analyzed the Carter Plan’s likely partisan performance. Ex. 1 at 23-25. He concluded that the Carter Plan’s partisan performance essentially matches that of the 2018 Remedial Plan, and

that it contains truly competitive districts. *Id.* Accordingly, the Carter Plan will be both reflective of and responsive to Pennsylvanians' statewide partisan preferences.

CONCLUSION

For the foregoing reasons, the *Carter* Petitioners respectfully request that this Court adopt their proposed congressional redistricting plan.

Respectfully submitted,

/s/ Edward D. Rogers

Counsel for the Carter Petitioners

Exhibit 1

EXPERT REPORT OF JONATHAN RODDEN, Ph.D.

Carter v. Chapman, 464 MD 2021, 465 MD 2021 (Pa. Commw. Ct.)
January 24, 2022

In this report, I describe the Carter Plan, a proposed Pennsylvania congressional redistricting map that I was asked to create and which the *Carter* Petitioners are submitting for consideration pursuant to the Court's January 14, 2022 Order.

Specifically, I was asked to use the existing court-drawn 18-district plan as a guide, and to draw a new 17-district plan that is as similar as possible to the existing plan, preserving the cores and boundaries of districts where feasible given equal population requirements, and meeting or surpassing its adherence to traditional redistricting criteria, including (1) minimizing splits of counties, municipalities, and vote tabulation districts and (2) drawing compact districts. Moreover, I was asked to be mindful of the residential addresses of congressional incumbents to avoid inadvertent pairings of incumbent legislators. Finally, after completing my map, I was asked to evaluate the districts' partisan performance.

The most important constraint shaping this task was the demographic change experienced by Pennsylvania since the 2010 census. The metropolitan areas of the state have experienced population growth on par with the United States as a whole, while rural Pennsylvania has experienced a precipitous decline in population. As a result of rural population loss, Pennsylvania lost a congressional seat. Accordingly, it is possible to make relatively small changes to the districts in Southeastern Pennsylvania and the Pittsburgh area, but the geographic size and configuration of districts in the rest of the state, which is more rural, needed to change more substantially to preserve population equality.

This report explains those demographic constraints in greater detail, and then presents a proposed congressional map that maintains continuity with the 2018 plan and adheres to traditional redistricting criteria. Despite the challenges associated with the loss of a district, this map shows that it is possible to preserve a relatively similar level of compactness as the current map, split the same number of counties, and reduce the number of split municipalities and vote tabulation districts. Furthermore, the resulting map is likely to result in a seat share that is consistent with and responsive to Pennsylvania voters' partisan preferences.

I. QUALIFICATIONS AND EXPERIENCE

I am currently a tenured Professor of Political Science at Stanford University and the founder and director of the Stanford Spatial Social Science Lab—a center for research and teaching with a focus on the analysis of geo-spatial data in the social sciences. I am engaged in a variety of research projects involving large, fine-grained geo-spatial data sets including ballots and election results at the level of polling places, individual records of registered voters, census data, and survey responses. I am also a senior fellow at the Stanford Institute for Economic Policy Research and the Hoover Institution. Prior to my employment at Stanford, I was the Ford Professor of Political Science at the Massachusetts Institute of Technology. I received my Ph.D. from Yale University and my B.A. from the University of Michigan, Ann Arbor, both in political science. A copy of my current C.V. is included as Exhibit A.

In my current academic work, I conduct research on the relationship between the patterns of political representation, geographic location of demographic and partisan groups, and the drawing of electoral districts. I have published papers using statistical methods to assess political geography, balloting, and representation in a variety of academic journals including *Statistics and Public Policy*, *Proceedings of the National Academy of Science*, *American Economic Review Papers and Proceedings*, the *Journal of Economic Perspectives*, the *Virginia Law Review*, the *American Journal of Political Science*, the *British Journal of Political Science*, the *Annual Review of Political Science*, and the *Journal of Politics*. One of these papers was selected by the American Political Science Association as the winner of the Michael Wallerstein Award for the best paper on political economy published in the last year, and another received an award from the American Political Science Association section on social networks. In 2021, I received a John Simon Guggenheim Memorial Foundation Fellowship, and received the Martha Derthick Award of the American Political Science Association for “the best book published at least ten years ago that has made a lasting contribution to the study of federalism and intergovernmental relations.”

I have recently written a series of papers, along with my co-authors, using automated redistricting algorithms to assess partisan gerrymandering. This work has been published in the *Quarterly Journal of Political Science*, *Election Law Journal*, and *Political Analysis*, and it has been featured in more popular publications like the *Wall Street Journal*, the *New York Times*, and *Boston Review*. I recently published a book, published by *Basic Books* in June of 2019, on the relationship between political districts, the residential geography of social groups, and their political representation in the United States and other countries that use winner-take-all electoral districts. The book was reviewed in *The New York Times*, *The New York Review of Books*, *Wall Street Journal*, *The Economist*, and *The Atlantic*, among others. This book included deep analysis of Pennsylvania’s political geography and redistricting.

I have expertise in the use of large data sets and geographic information systems (GIS), and conduct research and teaching in the area of applied statistics related to elections. My PhD students frequently take academic and private sector jobs as statisticians and data scientists. I frequently work with geo-coded voter files and other large administrative data sets, including in recent paper published in the *Annals of Internal Medicine* and *The New England Journal of Medicine*. I have developed a national data set of geo-coded precinct-level election results that has been used extensively in policy-oriented research related to redistricting and representation.

I have been accepted and testified as an expert witness in six election law and redistricting cases: *Romo v. Detzner*, No. 2012-CA-000412 (Fla. Cir. Ct. 2012); *Mo. State Conference of the NAACP v. Ferguson-Florissant Sch. Dist.*, No. 4:2014-CV-02077 (E.D. Mo. 2014); *Lee v. Va. State Bd. of Elections*, No. 3:15-CV-00357 (E.D. Va. 2015); *Democratic Nat'l Committee et al. v. Hobbs et al.*, No. 16-1065-PHX-DLR (D. Ariz. 2016); *Bethune-Hill v. Virginia State Board of Elections*, No. 3:14-cv-00852-REP-AWA-BMK (E.D. Va. 2014); and *Jacobson et al. v. Lee*, No. 4:18-cv-00262 (N.D. Fla. 2018). Just earlier this month, the Ohio Supreme Court credited my expert analysis in *Bennett v. Ohio Redistricting Commission*, No. 2012-1198 (Ohio 2022), and *Adams v. DeWine*, No. 2012-1428 (Ohio 2022), two redistricting cases challenging state legislative and congressional maps. I also worked with a coalition of academics to file Amicus Briefs in the Supreme Court in *Gill v. Whitford*, No. 16-1161, and *Rucho v. Common Cause*, No. 18-422. Much of the testimony in these cases had to do with geography, electoral districts, voting, ballots, and

election administration. I am currently working as a consultant for the Maryland Redistricting Commission.

I am being compensated at the rate of \$550/hour for my work in this case. My compensation is not dependent upon my conclusions in any way.

II. DATA SOURCES

In order to assess statewide partisanship, I have collected statewide election results for selected elections from 2010 to 2020 from the Pennsylvania Department of State.¹ The specific elections and results are detailed in Table 1 below. As part of my analysis of the relationship between population change and partisanship, I also collected county-level results of those same elections from the Pennsylvania Department of State. In order to assess the partisanship of the existing Pennsylvania Congressional districts as well as the proposed Carter Plan, I also accessed precinct-level election results from the Pennsylvania Department of State for statewide elections from 2016 to 2020 that were matched to 2020 Pennsylvania vote tabulation districts by a team at Harvard University called the Algorithm-Assisted Redistricting Methodology Project.² I also used block-level 2020 population estimates produced by the United States Census Department for the purposes of legislative redistricting. Additionally, I accessed the boundaries of current legislative districts and counties, along with data on 2010 and 2020 population, from the National Historical GIS (nhgis.org). I also accessed a file containing addresses of incumbents that was provided to me by counsel.

III. PENNSYLVANIA'S CURRENT CONGRESSIONAL DISTRICTS

Pennsylvania's current congressional plan was adopted in 2018 by an order of the Pennsylvania Supreme Court in *League of Women Voters of Pa. v. Commonwealth*, 645 Pa. 576 (2018) (LWV). In explaining its reasons for selecting this map, the Pennsylvania Supreme Court cited the map's superiority, compared with other maps that had been submitted, with respect to the traditional redistricting criteria of compactness and minimization of splits of counties, municipalities, and smaller political subdivisions. Indeed, the map stands out relative to those of many other U.S. states in that its districts are relatively compact and respectful of county and municipal boundaries.

As demonstrated by the elections of 2018 and 2020, the map also produced a congressional delegation that came very close to accurately portraying the partisan preferences of Pennsylvania's voters. In recent years, Pennsylvania has been a competitive but Democratic-leaning state. Table 1 displays results of all statewide elections since the last round of decennial redistricting. The average vote share of Democratic candidates during this period was almost 53 percent. Democratic candidates were victorious in 13 of 17 statewide races.

¹ <https://www.electionreturns.pa.gov/ReportCenter/Reports>

² <https://alarm-redist.github.io/posts/2021-08-10-census-2020/>

Table 1: Pennsylvania Statewide Election Results, 2012-2020

	Democratic votes	Republican votes	Democratic vote share
2012 President	2,990,274	2,680,434	52.73%
2012 Senate	3,021,364	2,509,132	54.63%
2012 Attorney General	3,125,557	2,313,506	57.46%
2012 Auditor General	2,729,565	2,548,767	51.71%
2012 Treasurer	2,872,344	2,405,654	54.42%
2014 Governor	1,920,355	1,575,511	54.93%
2016 Presidential	2,926,441	2,970,733	49.62%
2016 U.S. Senate	2,865,012	2,951,702	49.25%
2016 Attorney General	3,057,010	2,891,325	51.39%
2016 Auditor General	2,958,818	2,667,318	52.59%
2016 Treasurer	2,991,404	2,610,811	53.40%
2018 U.S. Senate	2,792,437	2,134,848	56.67%
2018 Governor	2,895,652	2,039,882	58.67%
2020 Presidential	3,458,229	3,377,674	50.59%
2020 Attorney General	3,461,472	3,153,831	52.33%
2020 Auditor General	3,129,131	3,338,009	48.39%
2020 Treasurer	3,239,331	3,291,877	49.60%
2012-2020 Average			52.85%
2016-2020 Average			52.05%
2018-2020 Average			52.71%

Note: Democratic vote share is the Democratic share of the votes for the two major parties (Democrats and Republicans). The denominator does not include minor parties and write-in candidates.

Table 1 also provides vote share averages for more recent election cycles. From 2016 to 2020—the period for which I have accessed precinct-level election results that allow me to assess the likely partisanship of proposed new redistricting plans—the average Democratic vote share was around 52 percent. During the lifespan of the most recent redistricting plan, which was implemented in 2018, the average Democratic vote share was 52.7 percent.

Given this pattern of statewide election results, a congressional redistricting plan that produces a slight majority of Democratic members of Congress would be an accurate reflection of overall statewide partisanship. After the elections of 2018 and 2020, the Pennsylvania congressional delegation was split evenly between the two parties. In other words, the 2018 congressional plan was, if anything, slightly more favorable to the Republican Party—with 50 percent of the seats and a relatively stable statewide support base between 47 and 48 percent—than the overall statewide vote share.

However, it is important to note that several districts were quite competitive and could plausibly have been won by either party. The district-level results of the 2018 and 2020 elections are

presented on the left-hand side of Table 2 below, along with the average of the two. The districts are sorted from the most Republican to most Democratic, according to the average congressional vote share. Note that Districts 1 (Bucks County), 10 (metro Harrisburg), and 16 (Northwest PA) were very close in 2018—a relatively good year for Democrats—and Districts 7 (Lehigh Valley), 8 (Northeast PA), and 17 (suburban Pittsburgh) were quite close in 2020, which was a relatively good year for Republicans.

Table 2: Actual District-Level Results of 2018 and 2020 Elections and Statewide Election Results Disaggregated by Congressional District

District	Democratic Congressional vote share, 2018	Democratic Congressional vote share, 2020	Average Democratic Congressional vote share, 2018-2020	Average Democratic <i>Statewide</i> vote share, 2018-2020	Over (under) performance of Democratic Congressional candidate
13	29.51%	26.51%	28.01%	29.35%	-1.34%
15	32.16%	26.54%	29.35%	31.56%	-2.21%
12	33.96%	29.16%	31.56%	33.22%	-1.66%
9	40.25%	33.67%	36.96%	37.12%	-0.16%
14	42.09%	35.31%	38.70%	40.66%	-1.96%
11	41.02%	36.88%	38.95%	39.02%	-0.07%
16	47.83%	40.66%	44.25%	43.36%	0.89%
1	48.74%	43.44%	46.09%	53.62%	-7.53%
10	48.68%	46.69%	47.68%	48.74%	-1.06%
8	54.64%	51.78%	53.21%	50.94%	2.27%
7	55.17%	51.87%	53.52%	53.68%	-0.16%
17	56.26%	51.15%	53.70%	53.99%	-0.29%
6	58.88%	56.05%	57.47%	56.71%	0.76%
4	63.52%	59.53%	61.52%	62.41%	-0.88%
5	65.19%	64.70%	64.94%	65.40%	-0.46%
18	Uncontested	69.25%	69.25%	68.06%	1.18%
2	79.02%	72.54%	75.78%	73.54%	2.23%
3	93.38%	91.03%	92.21%	92.34%	-0.14%

Note: Democratic vote share is the Democratic share of the votes for the two major parties (Democrats and Republicans). The denominator does not include minor parties and write-in candidates.

It is useful to make a distinction between actual district-level congressional election results, which are affected by idiosyncratic aspects of candidates' popularity, including strategic decisions by high-quality challengers to avoid running against popular incumbents, and what might be characterized as the underlying partisanship of the district. To capture the latter, political scientists often use precinct-level results of *statewide* elections, where the same candidates are running in each district, and count up the votes within the boundaries of legislative districts. I have also undertaken this approach, using the 6 statewide elections listed in Table 1 for 2018 and 2020 and taking an average for each district. These calculations are presented in the fifth column of Table 2. In the final column, I have subtracted the average statewide Democratic vote share from the

average congressional vote share, which provides an indicator of the extent to which the Democratic congressional candidate outperforms his or her statewide co-partisans (positive numbers), or to which the Republican candidate outperforms his or her statewide co-partisans (negative numbers).

This exercise reveals that while statewide and congressional election results are highly correlated, there are some interesting and sometimes sizable differences between statewide and congressional races. Above all, note that if we focus only on *statewide* races, there are 10 districts with Democratic majorities rather than 9. District 1 has an average Democratic vote share of 53.6 percent, yet the Republican incumbent from the previous Bucks County district, Mike Fitzpatrick, received 51.3 percent of the vote in 2018 and a comfortable 56.6 percent in 2020.

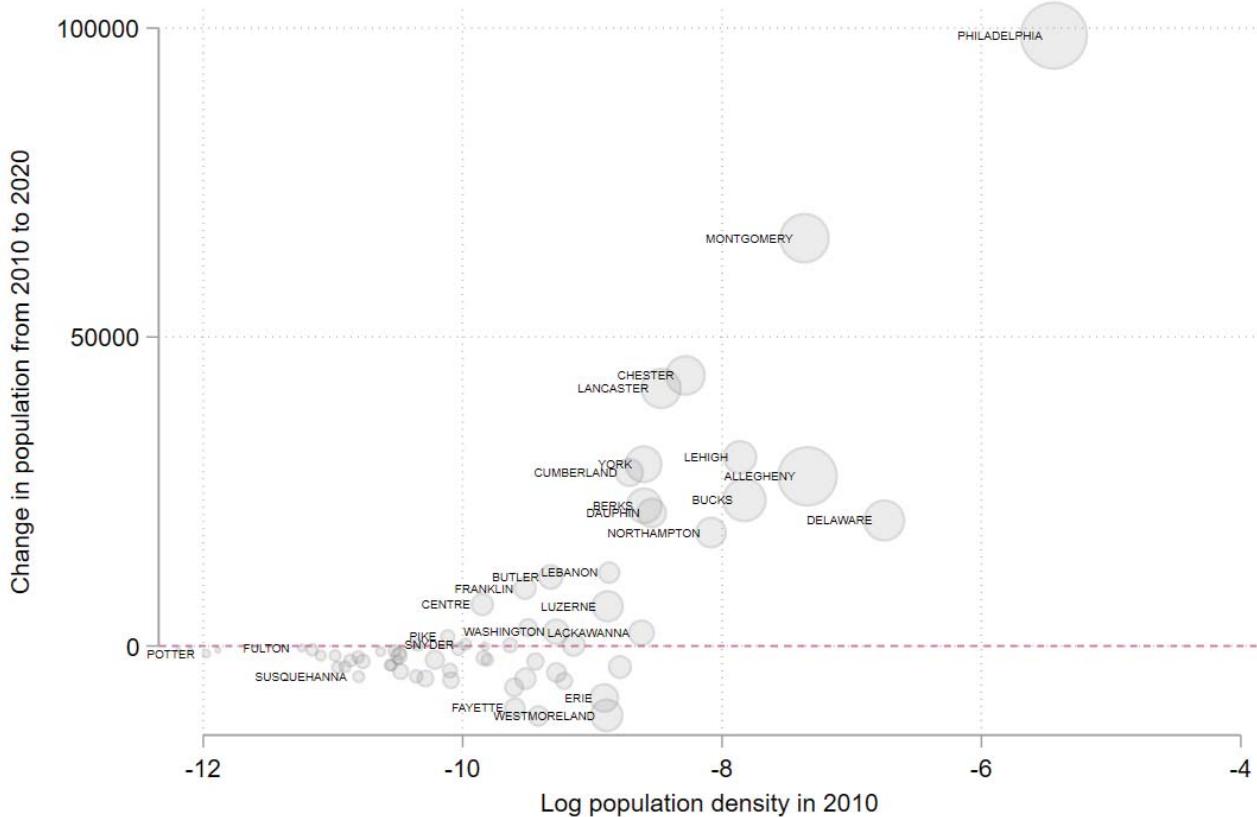
In keeping with a narrow but consistent statewide Democratic majority, the previous plan had 10 of 18 districts where Democratic candidates received majorities in statewide races, though one of these, District 8 in Northeastern Pennsylvania, was very close to evenly divided (less than 51 percent Democratic). Additionally, one of the Republican-leaning districts, number 10 in the Harrisburg area, was also rather evenly divided (a little over 51 percent Republican). When it comes to actual congressional election results, several were quite competitive, and due to a popular Republican incumbent in District 1, the delegation ended up evenly divided between the parties.

In sum, the existing plan demonstrates several desirable features. In addition to having relatively compact districts with few splits of counties and municipalities, it also produces relatively competitive elections, and outcomes that are roughly in line with overall partisan preferences of Pennsylvania's voters. Thus, it is a very reasonable starting point for the redistricting process in 2022.

IV. DEMOGRAPHIC CHANGE IN PENNSYLVANIA

To understand the constraints shaping a redistricting strategy based on the preservation of existing districts, it is necessary to understand the geography of Pennsylvania's population change over the last decade.

For the most part, places that were sparsely populated in 2010 subsequently lost population and became even sparser, while relatively dense places gained population and grew denser. This simple pattern can be visualized in Figure 1, which displays the log of 2010 population density on the horizontal axis, and the change in population from 2010 to 2020 on the vertical axis. Each data marker is a county, and the size of the data marker corresponds to the overall population of the county. The county that gained the most population, on the right side of the graph, was Philadelphia—the densest county in the state. Other counties experiencing relatively large increases in population were other relatively dense counties in the metro area surrounding Philadelphia County, e.g., Chester and Montgomery. With a few exceptions, e.g., Centre County and Butler County, Pennsylvania's relatively sparse counties lost population.

Figure 1: Population Density and Population Change in Pennsylvania, 2010 to 2020

In other words, metropolitan areas gained significant population, while rural areas experienced substantial population loss. In particular, the counties of Southeastern Pennsylvania experienced sustained population growth. In fact, from the decennial census of 2010 to that of 2020, these counties grew at an average rate of 6.7 percent.³ This is relatively close to the overall growth rate of the U.S. population during the same period, which was 7.3 percent. In fact, the rate of population growth in Chester, Lehigh, and Montgomery Counties surpassed 8 percent. Dauphin County, home to Harrisburg, grew at a rate of 8.1 percent, while Allegheny County, home to Pittsburgh, grew at a rate of 2.2 percent. Meanwhile, the rest of the state *lost* population at a rate of 2.7 percent since 2010.

These patterns can be visualized in Figure 2, which displays raw numbers of population gain and loss by county from 2010 to 2020, along with the boundaries of the current 18 congressional districts.

³ I include the counties of Bucks, Berks, Chester, Delaware, Lancaster, Lehigh, Montgomery, Northampton, and Philadelphia.

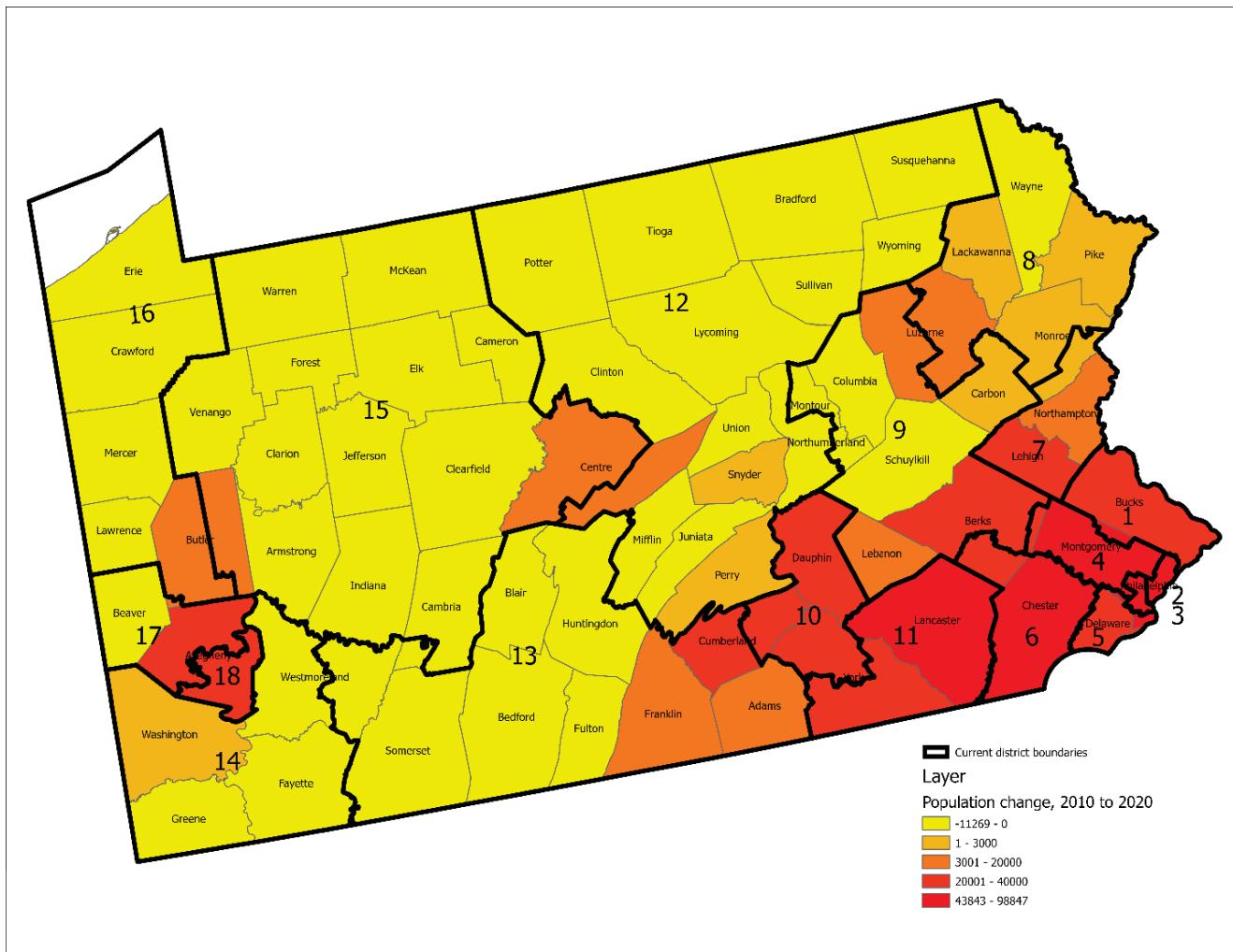
Figure 2: The Geography of Population Shifts, Pennsylvania Counties, 2010 to 2020

Figure 2 makes it clear that Pennsylvania lost a congressional district largely because of population decline outside of metropolitan areas. As a result, major reconfigurations of existing districts are unavoidable in rural Pennsylvania, whereas the districts in metropolitan areas can be fine-tuned based on local variation in the rate of population growth.

In the previous redistricting plan, which was very careful to avoid county splits, Philadelphia County was entirely contained within two congressional districts. Because population growth in Philadelphia was not far off from that of the average national rate, its districts need not change much at all. But because Bucks and Delaware counties experienced lower growth rates, Districts 1 and 5 must expand further beyond the confines of their counties. This is somewhat challenging, since the surrounding counties of Montgomery, Chester, and Lancaster have experienced rapid population growth. The expansions of Districts 1 and 5 must either dig further into Montgomery County, making its district (District 4) narrower and less compact, or completely disrupt the current map's effort to avoid county splits in Chester, Lancaster, Lehigh, and Northampton. In the map presented below, I have elected to maintain the structure of the existing map and reach further into Montgomery County with Districts 1 and 5 (see below for more details).

Moving North from the Philadelphia metro area, moderate population growth in the counties contained in the current version of Districts 7 and 8 makes it possible to leave the basic structure of these districts intact. Likewise, moving West from Philadelphia, District 11 (based in Lancaster County) and District 10 (based in the Harrisburg area) require relatively minor changes due to population growth that is close to the national average.

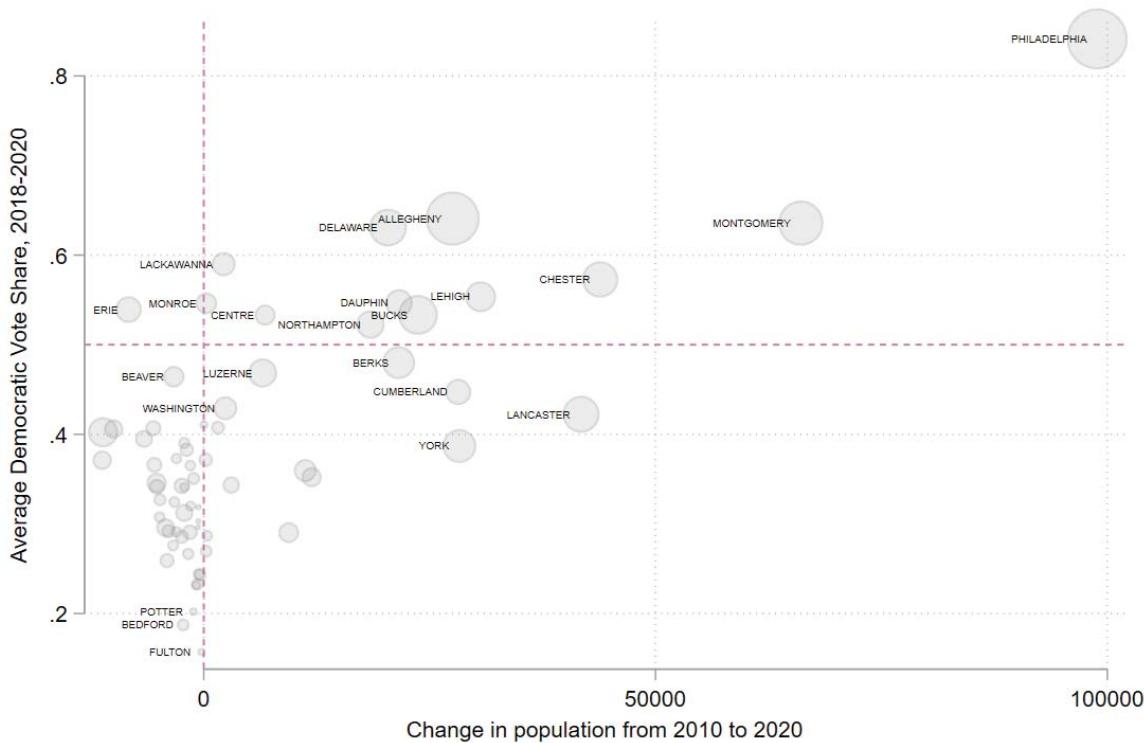
In metro Pittsburgh, the current map places the city of Pittsburgh and its Southern and Eastern suburbs into District 18, with the remainder of Allegheny County and Beaver County placed in District 17. Again, due to moderate population growth, it is straightforward to retain the existing arrangement. This can be achieved by simply moving a small part of suburban Pittsburgh into District 17 and expanding what was formerly called District 18 a bit further into Pittsburgh's exurbs in Westmoreland County.

Due to population loss, the territories of Districts 14 and 16, in the Western corners of the state, must expand toward the central part of the state. In the central part of the state, large population losses, combined with the unavoidable expansion of Districts 14 and 16 into their territory, mean that the area formerly covered by Districts 9, 12, 13, and 15 must now be covered by only three districts rather than four. Each of these districts is currently represented by a Republican incumbent. As a result, unless the map undergoes a more extensive redesign aimed explicitly at protecting these incumbents, two of them will be forced to compete in the same district.

It is worth noting that Pennsylvania's demographic changes are highly correlated with partisanship. In Pennsylvania, as in the rest of the United States, population density is highly correlated with Democratic voting.⁴ In Pennsylvania, as demonstrated in Figure 1, population growth is occurring in relatively dense areas. This means that the places that are gaining population are largely Democratic, and the places that are losing population are largely Republican. This pattern can be visualized in Figure 3, which plots the county-level change in population from 2010 to 2020 on the horizontal axis, and the average Democratic vote share from 2018 and 2020 on the vertical axis.

⁴ See Jonathan Rodden, *Why Cities Lose: The Deep Roots of the Urban-Rural Divide*. New York: Basic Books.

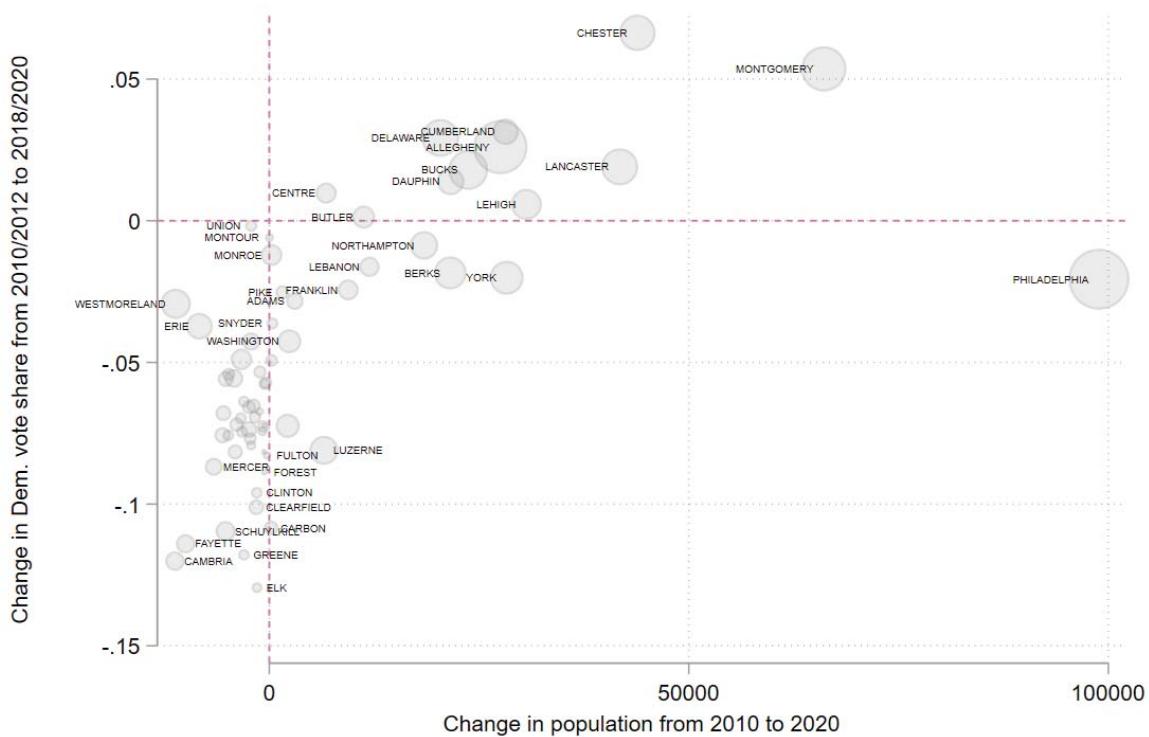
Figure 3: Population Change Since 2010 and Average Democratic Vote Share, Pennsylvania Counties



Moreover, another pronounced trend in Pennsylvania and the rest of the United States is that places that are gaining population are not only more Democratic to begin with, but are becoming *more* Democratic as they gain population. Likewise, places that are losing population are not only relatively Republican to begin with, but are becoming *more* Republican. This can be visualized in Figure 4 below, which, like Figure 3, depicts the change in population from 2010 to 2020 on the horizontal axis, but on the vertical axis, plots the *change* in the Democratic vote share from the average at the beginning of the decade (the 2010 mid-term and the 2012 presidential election) and the average at the end of the decade (the 2018 mid-term and the 2020 presidential election). Figure 4 demonstrates that many of the counties that are gaining the most population—like Chester, Montgomery, and Lancaster—are becoming more Democratic. Philadelphia—already extremely Democratic—is an exception to this pattern.

Note that some of the growing places that are becoming more Democratic, like Montgomery, Chester, and Allegheny Counties, were already quite Democratic. But others, like Lancaster and Cumberland, started out with strong Republican majorities, meaning that they are becoming more competitive over time as they gain population.

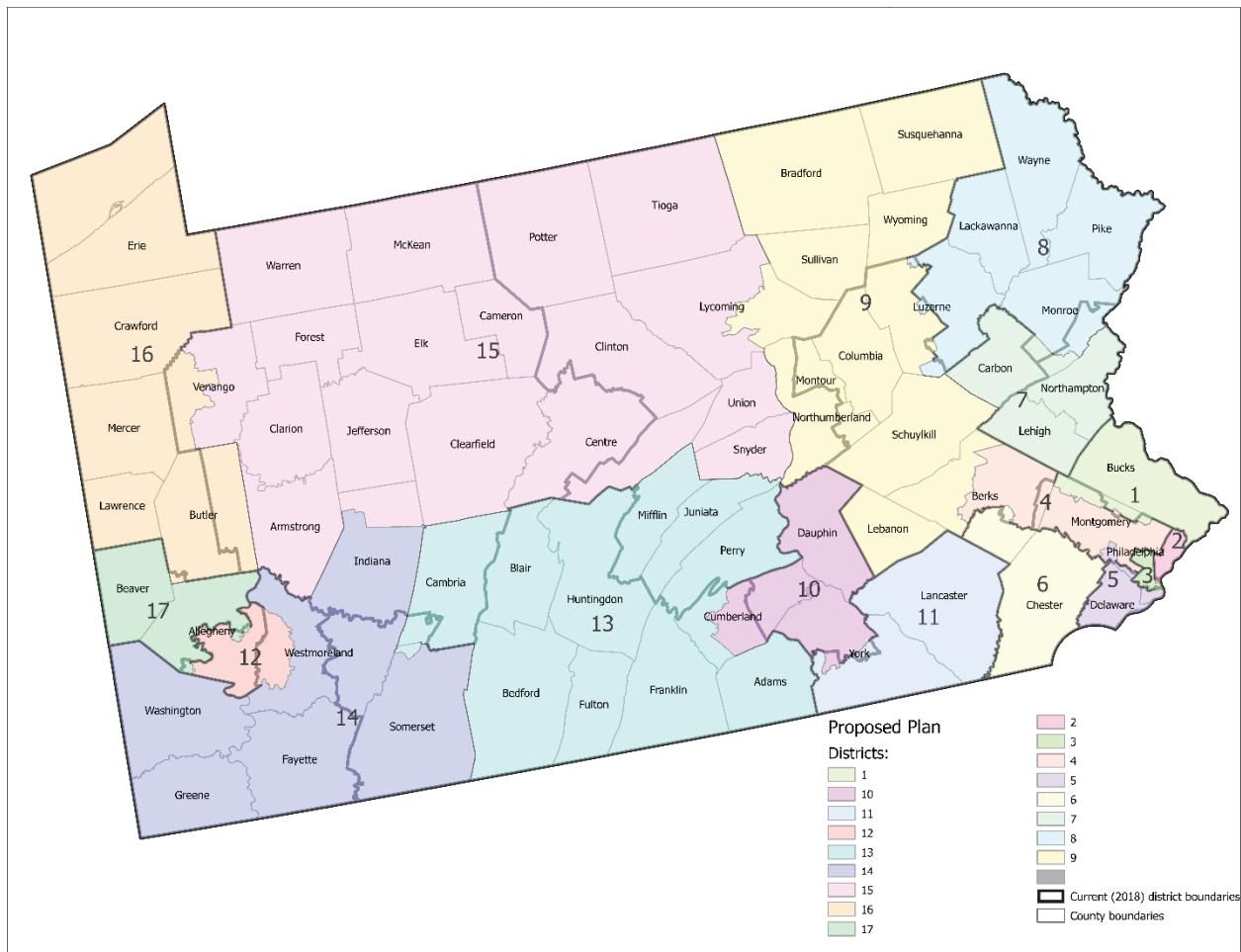
Figure 4: Population Change Since 2010 and Change in Average Democratic Vote Share, Pennsylvania Counties



V. REDISTRICTING PLAN

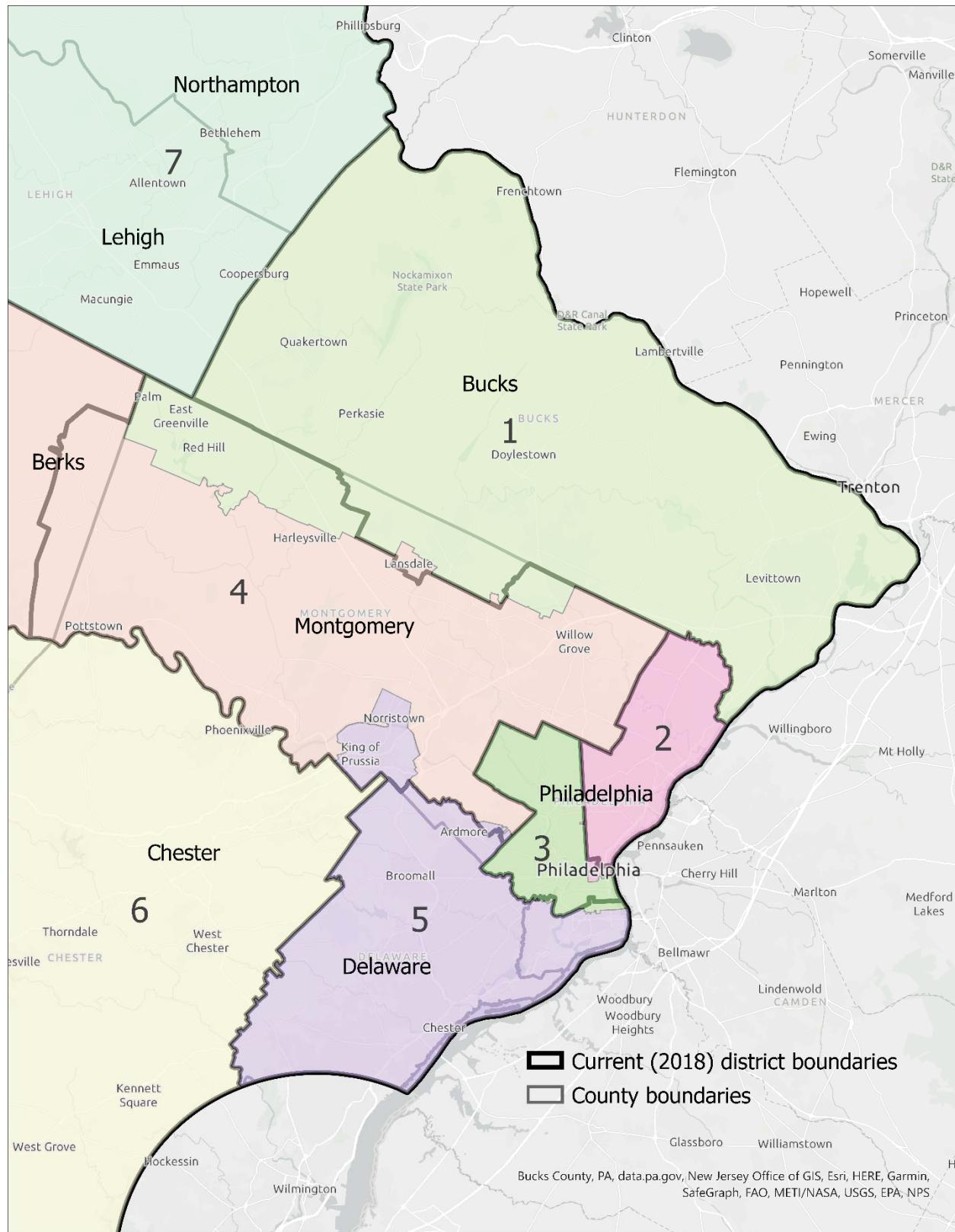
The Carter Plan is depicted in Figure 5, which also includes the boundaries of the previous (2018) plan, in thick gray, as well as the boundaries of Pennsylvania's counties in thin gray. It is immediately clear that the district boundaries have changed very little in most of Eastern Pennsylvania and the Pittsburgh area, where, as shown in Figure 2, population has grown over the past decade. In contrast, the boundaries in the central part of the state have changed more substantially to accommodate population loss.

Figure 5: Proposed Congressional District Boundaries



Let us begin by taking a closer look at the Philadelphia area, which is displayed in greater detail in Figure 6. First, in the 2018 plan, Philadelphia County was divided into two relatively compact districts, Districts 2 and 3, with a small portion of South Philadelphia spilling into District 5. Since Philadelphia's population growth has been quite close to overall U.S. population growth, I was able to retain this arrangement, while only slightly altering the boundaries of Districts 2 and 3 in order to achieve population equality.

Figure 6: Philadelphia Area



The previous version of District 1 was comprised mostly of Bucks County, which was kept whole, with a small segment reaching into Montgomery County. Since population growth in Bucks County has been somewhat slow relative to the country as a whole, District 1 required additional population in order to achieve population equality. I followed the same arrangement as before, but simply added additional county subdivisions along the border between Bucks and Montgomery.

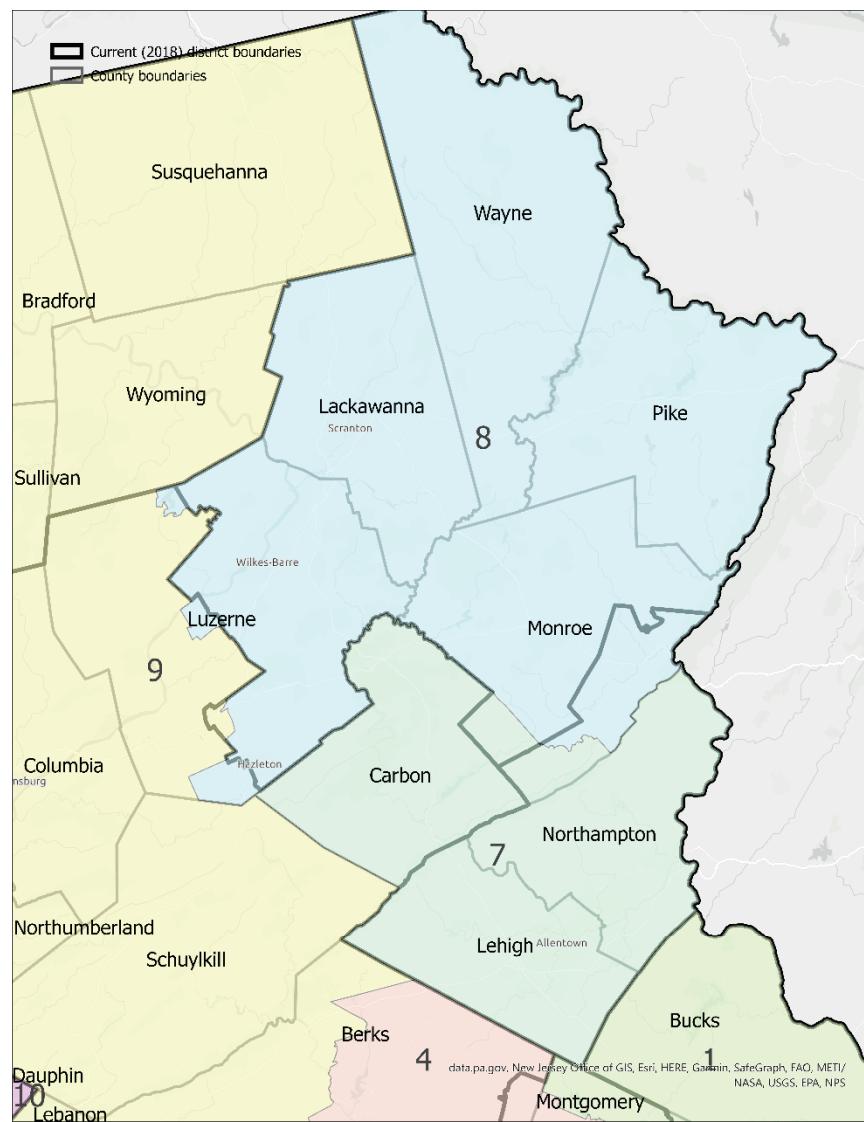
District 5 was based in Delaware County, with a portion reaching into South Philadelphia, and another reaching into Montgomery County. As with Bucks County, population growth was lackluster in District 5, so it was necessary to add population. Reaching into Chester County would have undermined the previous map's respect for several county boundaries to the West, so I elected once again to keep the structure of the existing map, reaching further into Montgomery County and including Norristown in District 5.

The downside of this approach is that it forces Montgomery County-based District 4 much further into Berks County than in the previous map. As quantified below, this makes District 4 less compact than the previous version. I considered alternative configurations that would have expanded District 5 into Chester County, but these approaches inevitably undermined the respect for county boundaries demonstrated by the previous map.

Next, the previous version of District 7 included the Lehigh Valley counties of Lehigh and Northampton and reached its population goal by extending Northward into part of Monroe County. Slow population growth in Northampton County meant that District 7 required additional population. I was able to unify Carbon County with the rest of the Lehigh Valley. The U.S. Census Department recognizes Allentown-Bethlehem-Easton as a metropolitan statistical area consisting of the entirety of Northampton, Lehigh, and Carbon Counties. These counties now constitute the core of District 7 (see Figure 7).

The previous version of District 8 was based in the Northeast corner of the state, including the Scranton-Wilkes-Barre corridor and extending to Hazleton in its Southwest corner. The district needed to add a small amount of population, which was possible to achieve by adding more of Monroe County as well as a couple of municipalities along the district's Western border in Luzerne County.

Figure 7: Districts 7 and 8

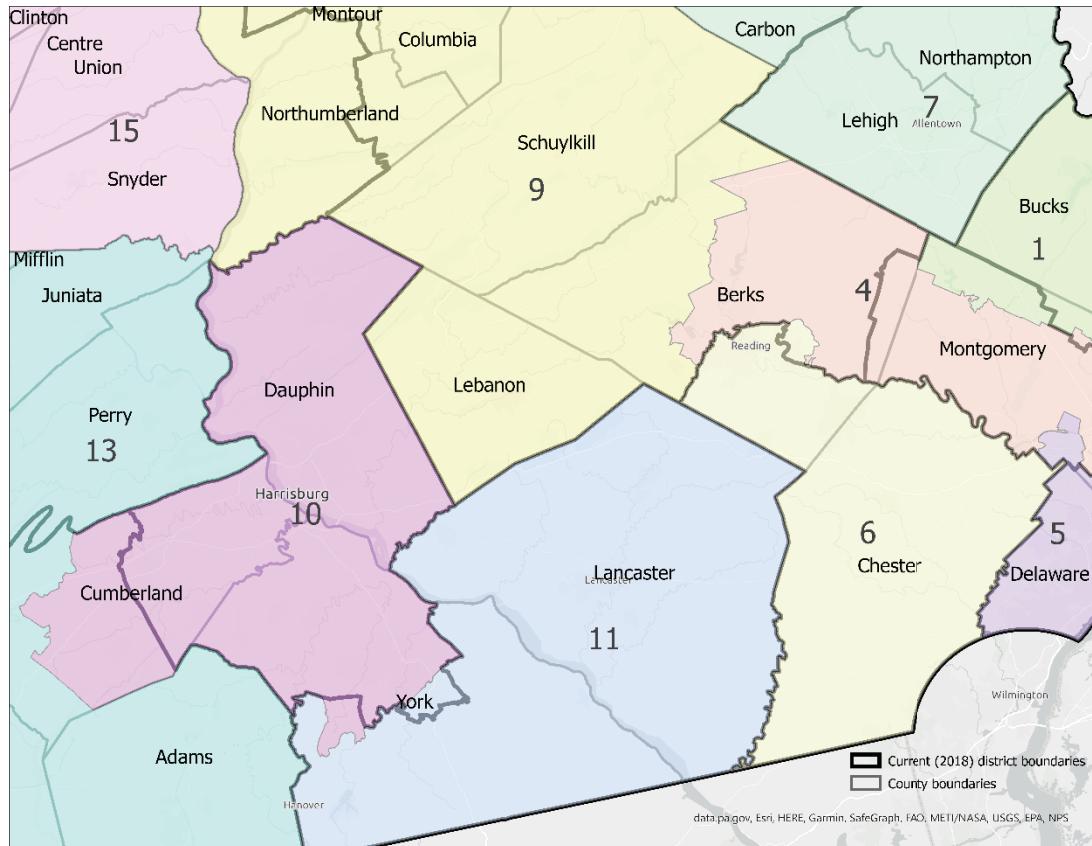


Due to healthy population growth on par with the national average, Districts 6, 10, and 11 required very little alteration (see Figure 8). As before, District 6 contains all of Chester as well as the Southwest corner of Berks County and the city of Reading. It was only necessary to add a small part of Exeter Township.

As in the previous map, District 11 contains all of Lancaster County and the Southern section of York County. It was only necessary to make small changes along the boundary between districts 10 and 11 in order to achieve population equality.

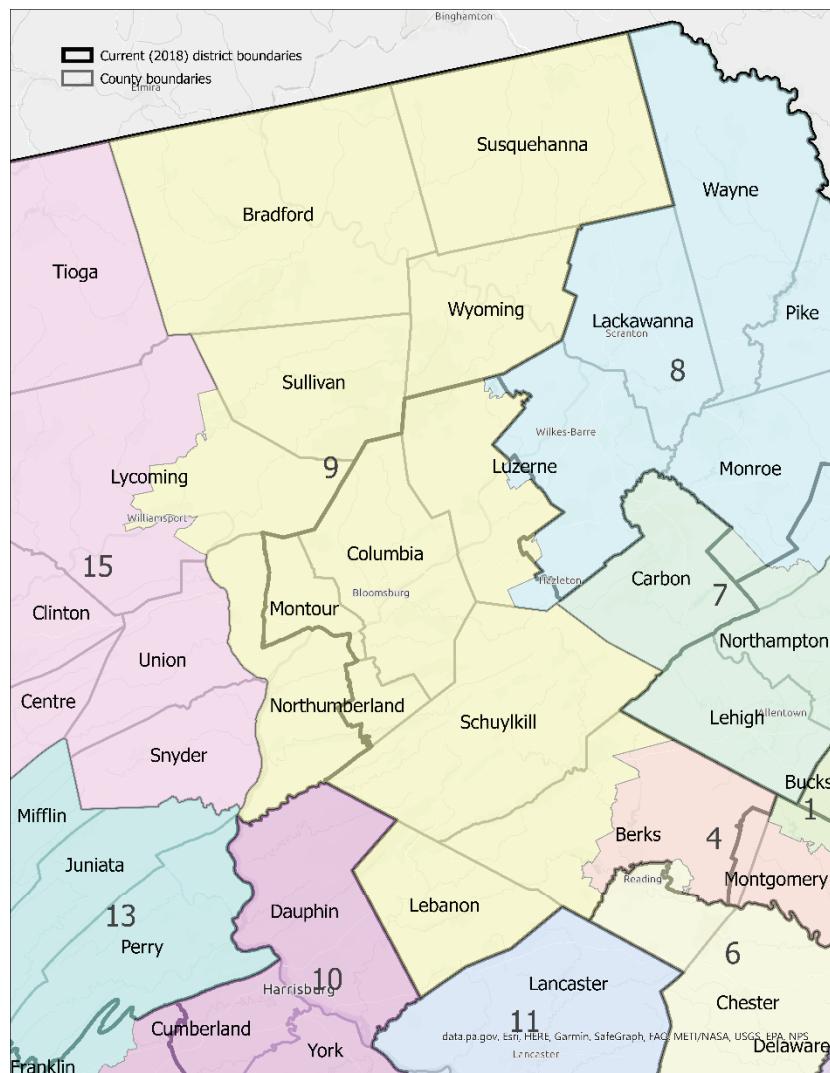
As before, District 10 is centered on the city of Harrisburg, which sits at the confluence of three counties: Dauphin, Cumberland, and York. The only noteworthy change is that the district needed to add a small amount of population by moving somewhat further West into Cumberland County.

Figure 8: Districts 6, 10, and 11



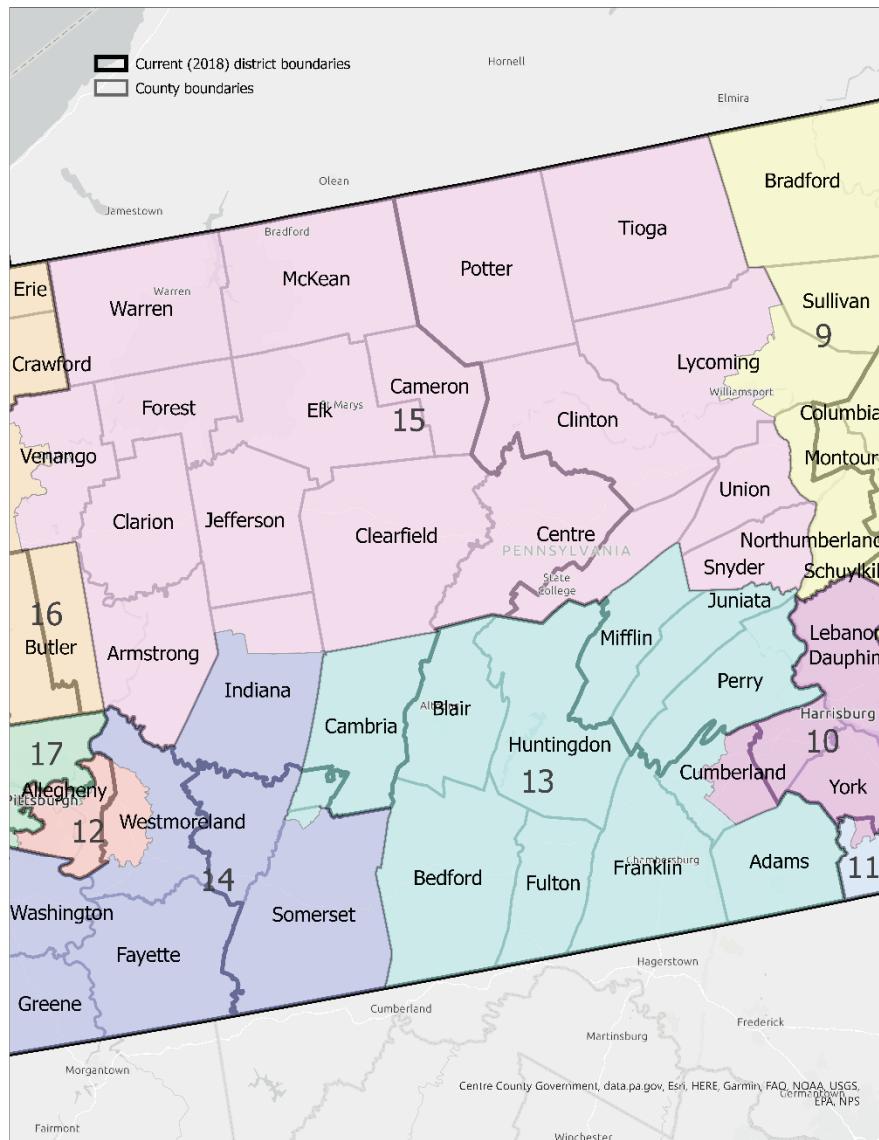
The boundaries of the former District 9 must change somewhat more substantially for a number of reasons (see Figure 9). The old version contained the counties of Columbia, Montour, part of Northumberland, Schuylkill, Carbon, Lebanon, and the rural Northern section of Berks County. However, Eastern counties have nowhere to grow but inwards, and as described above, Carbon County was placed in District 7 to unify a metropolitan statistical area. More importantly, Columbia, Schuylkill, Northumberland, and Montour counties all lost significant population. Thus, in order to achieve the target population, it was necessary for District 9 to grow to the North and West, taking the remainder of Northumberland, all of Bradford, Susquehanna, Sullivan, and Wyoming Counties, as well as part of Lycoming—all areas that had previously been in District 12, which due to severe population loss, cannot be retained.

Figure 9: District 9



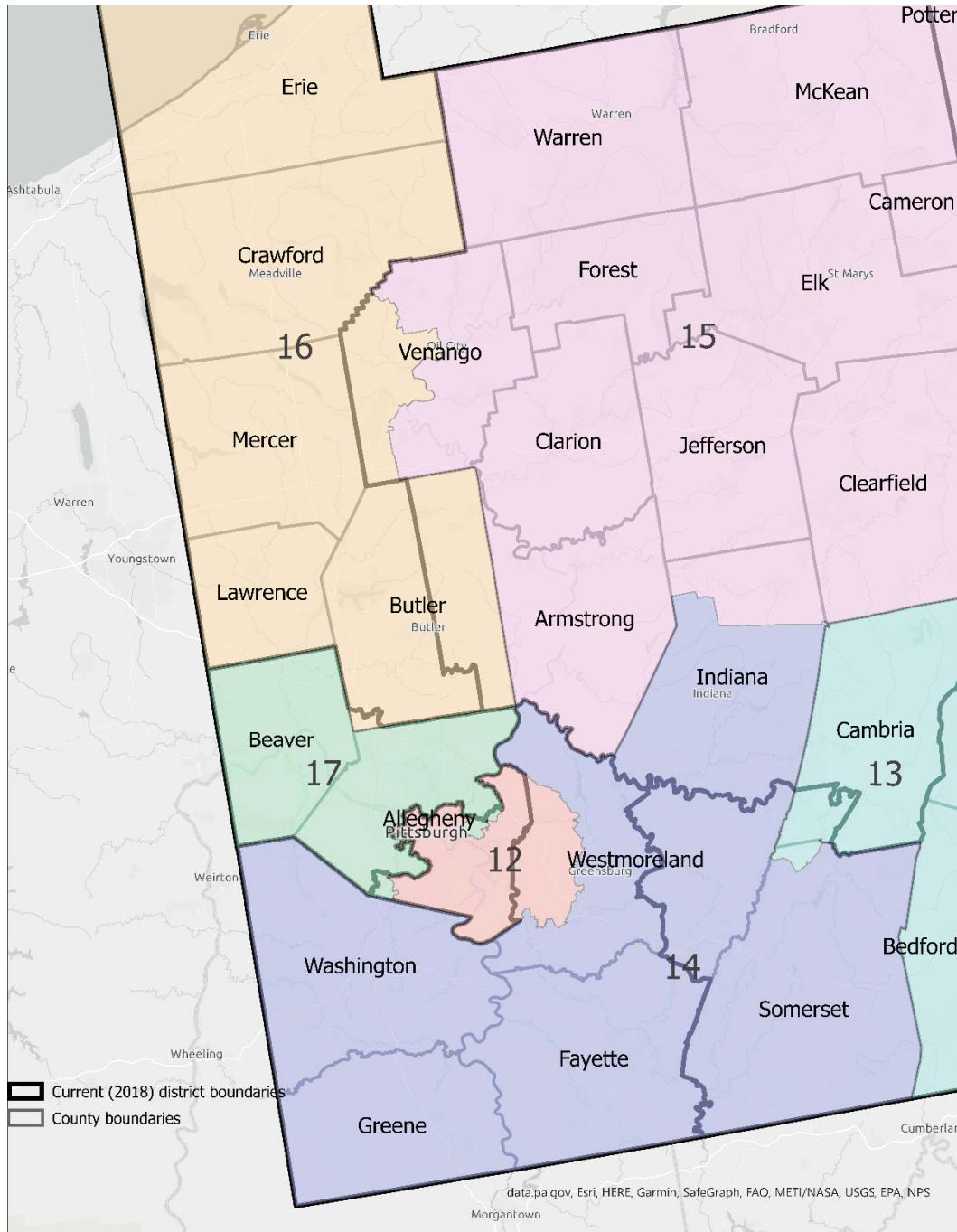
Due to population loss, the old version of District 15 must gain substantial population to its East. As this happens, it necessarily swallows much of the remainder of what was once District 12 (see Figure 10). The new version of District 15 is relatively compact and avoids a split of Centre County that had previously separated State College from some of its suburbs. Like District 15, District 13, which had included a number of rural counties in South-central Pennsylvania that are experiencing population loss, must expand to take the remainder of what was once District 12—the counties of Mifflin, Juniata, and Perry.

Figure 10: Districts 13 and 15



Now, let us consider the Western part of the state. The previous configuration included District 14 in the Southwest corner of the state, and District 16 in the Northwest corner of the state. Due to population loss, both needed to expand to the East. District 16 gained the remainder of Butler County, which had previously been split, and part of Venango County. District 14 expanded Eastward by taking the remainder of Westmoreland County and most of Indiana and Somerset Counties.

Figure 11: Western Pennsylvania (Districts 14, 12, 17, and 16)



Finally, it was straightforward to keep the structure of the metropolitan Pittsburgh districts the same. The previous District 18, now District 12, contained the city of Pittsburgh and its suburbs to the South and East, while District 17 contained the remaining parts of Allegheny County to the North and West of Pittsburgh, along with Beaver County. The boundary between Districts 17 and 18 was largely composed of the Pittsburgh City boundary. District 17 needed to gain a small amount of population. Without violating the boundary of the city of Pittsburgh, it was possible to do this by simply moving a handful of small suburban municipalities from District 18 to District 17. This left Pittsburgh-based District 18 (now 12) somewhat short of population, but it was possible to add this by simply appending suburban and exurban areas in Westmoreland County.

VI. PLAN STATISTICS

Retention of Existing Districts: As described above, I set out to retain the structure of the existing plan to the extent possible. Overall, 87 percent of the population of Pennsylvania falls in the same district as before, though what was formerly called District 18 is called District 12 in the Carter Plan. Table 3 provides information on the share of the population in each individual district in the Carter Plan that remains in the same district. As described above, Districts 9 and 15 changed the most, followed by District 13, as they unavoidably captured what was District 12 in the previous plan due to population loss in Central Pennsylvania. Therefore, it's unsurprising that residents of these two districts are less likely to have lived in the same district previously.

Table 3: Share of Population in Each Proposed District that Will be in the Same District as in the 2018 Plan

District	Share of population in previous version of district
1	93.26%
2	95.84%
3	94.17%
4	81.65%
5	89.74%
6	98.44%
7	90.56%
8	92.10%
9	65.54%
10	96.20%
11	96.91%
12(18)	85.50%
13	73.39%
14	75.65%
15	59.61%
16	89.95%
17	93.63%

Equal Population: Based on the 2020 Census, the ideal population of each congressional district is 764,865. The Carter Plan includes 4 districts with the ideal population and 13 districts with a deviation of plus or minus one person. District-level details are provided in Table 4.

Table 4: District Population Deviations⁵

District	Population	Deviation from Ideal
1	764866	1
2	764865	0
3	764864	-1
4	764865	0
5	764866	1
6	764864	-1
7	764865	0
8	764866	1
9	764864	-1
10	764864	-1
11	764864	-1
12	764864	-1
13	764864	-1
14	764866	1
15	764864	-1
16	764865	0
17	764864	-1

Contiguity: Each district in the Carter Plan is made up of contiguous territory.

Political Subdivision Splits: Additionally, I have attempted to minimize county splits. The Carter Plan splits 13 counties, 10 of which are split among 2 districts, and 3 of which are split among 3 districts. This amounts to a total of 16 splits. The previous 2018 plan also splits 13 counties, but four of those are split among 3 districts, for a total of 17 county splits. Note that I do not count as a county split a technically non-contiguous fragment of Chester County that contains six people and is marooned in Delaware County due to a bend in Brandywine Creek at the intersection with the Southern state boundary. I also do not count this as a county split in the 2018 redistricting plan, consistent with the Pennsylvania Supreme Court's approach. The counties in the Carter Plan that are split among three districts are Berks, Philadelphia, and Montgomery. The 2018 plan also split these same counties among three districts, in addition to Butler County, but I was able to eliminate a split contained in the previous plan in the Southwest corner of Butler County.

⁵ The population of each district remains the same whether one uses the 2020 Census redistricting data or the Legislative Reapportionment Commission's Data Set #1.

The Carter Plan splits the city of Philadelphia between 3 districts and also splits the following 18 county subdivisions between two districts: Horsham and Lower and Upper Marion Townships in Montgomery County; Exeter, Lower Heidelberg, and Perry Townships in Berks County; Ross Township in Monroe County; Newport and Butler Townships in Luzerne County; Jackson Township in York County; North Newton Township in Cumberland County; the city of Williamsport in Lycoming County; Victory Township in Venango County; Swissvale Borough in Allegheny County; Hempfield and South Huntingdon Townships in Westmoreland County; Conemaugh Township in Somerset County; South Mahoning Township in Indiana County. The previous plan also split 19 county subdivisions.

The Carter Plan splits only 14 vote tabulation districts. This is a substantial improvement over the previous 2018 plan, which split 32 VTDs.

Compactness: I also attempted to retain the overall compactness of the previous plan. Table 5 provides compactness statistics for the same measures of compactness relied upon by the Court in its deliberations in 2018. For each of these scores, higher numbers indicate more-compact districts.

Table 5: Compactness Statistics: Previous (2018) Plan and Proposed Plan

District	Reock, Carter	Reock, 2018 plan	Schwartzberg, Carter	Schwartzberg, 2018 plan	Polsby-Popper, Carter	Polsby-Popper, 2018 plan	Population Polygon, Carter	Population Polygon, 2018 plan	Area/Convex Hull, Carter	Area/Convex Hull, 2018 plan
1	0.4	0.43	1.5	1.43	0.4	0.46	0.75	0.78	0.82	0.83
2	0.33	0.37	1.49	1.42	0.42	0.47	0.92	0.96	0.84	0.86
3	0.4	0.43	1.72	1.63	0.32	0.36	0.78	0.8	0.72	0.74
4	0.27	0.41	2.29	1.73	0.17	0.31	0.51	0.64	0.68	0.81
5	0.41	0.44	1.86	1.54	0.27	0.38	0.6	0.69	0.72	0.84
6	0.45	0.45	1.68	1.69	0.29	0.29	0.83	0.82	0.73	0.72
7	0.57	0.41	1.45	1.5	0.42	0.42	0.92	0.95	0.78	0.83
8	0.47	0.49	1.67	1.73	0.28	0.28	0.91	0.88	0.74	0.75
9	0.41	0.55	1.83	1.94	0.28	0.25	0.54	0.53	0.74	0.74
10	0.49	0.49	1.76	1.72	0.27	0.29	0.86	0.88	0.71	0.76
11	0.45	0.45	1.49	1.51	0.37	0.37	0.79	0.78	0.88	0.88
12 (18)	0.63	0.46	2.13	2.21	0.18	0.18	0.75	0.75	0.78	0.72
13	0.56	0.4	1.56	1.81	0.39	0.26	0.68	0.75	0.83	0.79
14	0.47	0.54	1.76	1.63	0.3	0.34	0.35	0.37	0.76	0.77
15	0.57	0.67	1.49	1.46	0.43	0.42	0.74	0.69	0.86	0.86
16	0.36	0.32	1.42	1.43	0.39	0.38	0.92	0.87	0.87	0.8
17	0.51	0.51	1.85	1.8	0.26	0.28	0.6	0.6	0.76	0.76
Average	0.46	0.46	1.7	1.67	0.32	0.33	0.73	0.74	0.78	0.79

Averaging across all districts, the compactness of the Carter Plan is similar to that of the previous plan when examining the Reock score, and slightly more compact when considering the Schwartzberg score. The Carter Plan is very slightly less compact than the existing plan when using the Polsby-Popper, Population Polygon, and Area/Convex Hull scores. Table 5 reveals that this difference is driven largely by Districts 4 and 5, which, as described above, had to become somewhat less compact in order to accommodate asymmetries in the rate of population growth between Montgomery, Delaware, and Bucks counties while minimizing county splits in Southeastern Pennsylvania.

Minority Representation: I did not consider racial data as I was drawing districts or making adjustments for population changes in the map.

Incumbent Addresses: I considered incumbent addresses to confirm that I was not inadvertently double-bunking sitting congressional representatives in the same district. Since I made very minor changes to most districts, as described above, I did not inadvertently remove any incumbents from their existing districts. Note that Representative Dean, the incumbent in District 4, appears to have recently moved to a new address a short distance away from the previous address, both of which are in Montgomery County. However, the new address is also in District 4, both in its previous manifestation and in the Carter Plan's configuration. As described above, it was not possible to avoid placing Rep. Keller from District 12, which was lost due to population loss, with another rural representative. The Carter Plan ends up placing Rep. Keller in District 15, along with incumbent Rep. Thompson. The consideration of these residential addresses had no impact on the Carter Plan's satisfaction of traditional redistricting criteria.

Partisan Performance: I did not consider partisan performance as I was drawing the map. However, upon analysis, the proposed redistricting plan is quite similar to the previous plan in terms of partisanship. Of course, it is not possible to examine results of congressional races that have not yet occurred. To draw inferences about the partisanship of these districts, it is useful to begin by adding up precinct-level results of recent statewide elections within the proposed boundaries. In Table 6, I do this for statewide elections from 2016 to 2020, taking an average for each district, and in order to facilitate comparisons with the previous (2018) plan, presented above in Table 2, I also focus on elections from 2018 to 2020 only.

As in the previous plan, there are 10 metropolitan districts where in statewide races, the average Democratic vote share is above 50 percent. These are the same 10 districts for which this was true in the previous plan. This is not surprising, since as described above, the metropolitan districts required minimal change to equalize population and thus retained many of the same voters.

It should be noted, however, that several of these districts are very evenly divided between the parties and, as described above, incumbent legislators often over- or under-perform relative to their statewide co-partisans—sometimes quite substantially. Fortunately, because there is so much overlap between the old and new districts, and since incumbents are running in each of the highly competitive districts, it is possible to do better than simply relying on the statewide aggregates when assessing the most likely outcomes of future elections.

Table 6: Statewide Election Results Aggregated to the Proposed Congressional Boundaries

District	Average Democratic Statewide vote share, 2016-2020	Average Democratic Statewide vote share, 2018-2020
1	51.81%	53.00%
2	74.57%	74.03%
3	91.11%	91.32%
4	58.59%	60.07%
5	64.67%	65.82%
6	55.01%	56.56%
7	50.88%	51.70%
8	51.01%	51.62%
9	33.42%	33.82%
10	46.81%	48.15%
11	38.37%	39.30%
12	62.03%	63.06%
13	29.12%	29.19%
14	38.39%	38.76%
15	33.51%	33.51%
16	41.55%	42.39%
17	53.99%	55.52%

In two of the districts with nominal Democratic majorities, these majorities are very narrow. In District 7, the average statewide Democratic vote share is between 50.9 percent and 51.7 percent, depending on which elections are included. As conveyed in Table 2 above, on average, the vote share of the Democratic incumbent in District 7 is slightly lower than that of her statewide Democratic co-partisans. As a result, District 7 can be viewed as a tossup district with a very slight Democratic lean.

In District 8, the average statewide Democratic vote share is between 51 percent and 51.6 percent, depending on which elections are used. Since Matt Cartwright, the Democratic incumbent, outperforms his statewide co-partisans by around 2 percentage points, this should be seen as a competitive but Democratic-leaning district. Even a relatively modest pro-Republican wave has the potential to unseat the incumbents in both Districts 7 and 8.

In District 1, the average statewide Democratic vote share is between 51.8 percent and 53 percent. However, as demonstrated above, on average, the incumbent Republican candidate, Representative Fitzpatrick, outperformed his statewide co-partisans by an astounding 7.5 percentage points. There is no reason to anticipate that this advantage will suddenly disappear, especially since 93 percent of the people in District 1 in the Carter Plan already lived in the district

that has repeatedly elected Representative Fitzpatrick in the past. If we use all the information at hand, District 1 should be understood as a very likely Republican district.

The other relatively competitive district is number 10, which contains metro Harrisburg and surroundings. The average Republican statewide vote share in this district is between 51.9 percent and 53.2 percent. The incumbent in this district, where 96 percent of voters are the same as before, outperforms his statewide co-partisans by a little over 1 percentage point. This makes District 10 a likely Republican seat, but one that could potentially change hands in the event of a very large pro-Democratic wave.

In sum, using all the information at our disposal, the proposed plan produces 8 districts where Democrats are expected to win, one of which (District 8) is potentially quite competitive; 8 districts where Republicans are quite likely to win, two of which are at least potentially competitive (1 and 10); and one district (District 7) that is a toss-up with a very slight Democratic lean. This level of partisan balance and competitiveness is similar to that of the existing plan, reflective of Pennsylvania's statewide partisan preferences, and consistent with changes in population as they relate to partisanship.

VII. CONCLUSION

The remedial redistricting plan endorsed by the Pennsylvania Supreme Court in 2018 demonstrated numerous admirable features including adherence to traditional redistricting principles as well as partisan fairness and responsiveness. This report introduces a new redistricting plan, the Carter Plan, that builds on those achievements, preserving the architecture of districts and matching or surpassing the previous plan with respect to compactness, contiguity, population equality, and splits of counties, county subdivisions, and vote tabulation districts. Moreover, this plan is likely to produce a Congressional delegation that reflects the statewide partisan preferences of Pennsylvanians, and one that changes in response to changes in those preferences.

I hereby certify that the foregoing statements are true and correct to the best of my knowledge, information, and belief. This verification is made subject to the penalties of 18 Pa.C.S. § 4904 relating to unsworn falsification to authorities.



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January 24, 2022

Exhibit A

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Personal

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Education

Ph.D. Political Science, Yale University, 2000.

Fulbright Scholar, University of Leipzig, Germany, 1993–1994.

B.A., Political Science, University of Michigan, 1993.

Academic Positions

Professor, Department of Political Science, Stanford University, 2012–present.

Senior Fellow, Stanford Institute for Economic Policy Research, 2020–present.

Senior Fellow, Hoover Institution, Stanford University, 2012–present.

Director, Spatial Social Science Lab, Stanford University, 2012–present.

W. Glenn Campbell and Rita Ricardo-Campbell National Fellow, Hoover Institution, Stanford University, 2010–2012.

Associate Professor, Department of Political Science, Stanford University, 2007–2012.

Fellow, Center for Advanced Study in the Behavioral Sciences, Palo Alto, CA, 2006–2007.

Ford Career Development Associate Professor of Political Science, MIT, 2003–2006.

Visiting Scholar, Center for Basic Research in the Social Sciences, Harvard University, 2004.

Assistant Professor of Political Science, MIT, 1999–2003.

Instructor, Department of Political Science and School of Management, Yale University, 1997–1999.

Publications

Books

Why Cities Lose: The Deep Roots of the Urban-Rural Divide. Basic Books, 2019.

Decentralized Governance and Accountability: Academic Research and the Future of Donor Programming. Co-edited with Erik Wibbels, Cambridge University Press, 2019.

Hamilton's Paradox: The Promise and Peril of Fiscal Federalism, Cambridge University Press, 2006. Winner, Gregory Luebbert Award for Best Book in Comparative Politics, 2007; Martha Derthick Award for lasting contribution to the study of federalism, 2021.

Fiscal Decentralization and the Challenge of Hard Budget Constraints, MIT Press, 2003. Co-edited with Gunnar Eskeland and Jennie Litvack.

Peer Reviewed Journal Articles

Who Registers? Village Networks, Household Dynamics, and Voter Registration in Rural Uganda, 2021, *Comparative Political Studies* forthcoming (with Romain Ferrali, Guy Grossman, and Melina Platas).

Partisan Dislocation: A Precinct-Level Measure of Representation and Gerrymandering, 2021, *Political Analysis* forthcoming (with Daryl DeFord Nick Eubank).

Who is my Neighbor? The Spatial Efficiency of Partisanship, 2020, *Statistics and Public Policy* 7(1):87-100 (with Nick Eubank).

Handgun Ownership and Suicide in California, 2020, *New England Journal of Medicine* 382:2220-2229 (with David M. Studdert, Yifan Zhang, Sonja A. Swanson, Lea Prince, Erin E. Holsinger, Matthew J. Spittal, Garen J. Wintemute, and Matthew Miller).

Viral Voting: Social Networks and Political Participation, 2020, *Quarterly Journal of Political Science* (with Nick Eubank, Guy Grossman, and Melina Platas).

It Takes a Village: Peer Effects and Externalities in Technology Adoption, 2020, *American Journal of Political Science* (with Romain Ferrali, Guy Grossman, and Melina Platas). Winner, 2020 Best Conference Paper Award, American Political Science Association Network Section.

Assembly of the LongSHOT Cohort: Public Record Linkage on a Grand Scale, 2019, *Injury Prevention* (with Yifan Zhang, Erin Holsinger, Lea Prince, Sonja Swanson, Matthew Miller, Garen Wintemute, and David Studdert).

Crowdsourcing Accountability: ICT for Service Delivery, 2018, *World Development* 112: 74-87 (with Guy Grossman and Melina Platas).

Geography, Uncertainty, and Polarization, 2018, *Political Science Research and Methods* doi:10.1017/psrm.2018.12 (with Nolan McCarty, Boris Shor, Chris Tausanovitch, and Chris Warshaw).

Handgun Acquisitions in California after Two Mass Shootings, 2017, *Annals of Internal Medicine* 166(10):698-706. (with David Studdert, Yifan Zhang, Rob Hyndman, and Garen Wintemute).

Cutting Through the Thicket: Redistricting Simulations and the Detection of Partisan Gerrymanders, 2015, *Election Law Journal* 14,4:1-15 (with Jowei Chen).

The Achilles Heel of Plurality Systems: Geography and Representation in Multi-Party Democracies, 2015, *American Journal of Political Science* 59,4: 789-805 (with Ernesto Calvo). Winner, Michael Wallerstein Award for best paper in political economy, American Political Science Association.

Why has U.S. Policy Uncertainty Risen Since 1960?, 2014, *American Economic Review: Papers and Proceedings* May 2014 (with Nicholas Bloom, Brandice Canes-Wrone, Scott Baker, and Steven Davis).

Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures, 2013, *Quarterly Journal of Political Science* 8: 239-269 (with Jowei Chen).

How Should We Measure District-Level Public Opinion on Individual Issues?, 2012, *Journal of Politics* 74, 1: 203-219 (with Chris Warshaw).

Representation and Redistribution in Federations, 2011, *Proceedings of the National Academy of Sciences* 108, 21:8601-8604 (with Tiberiu Dragu).

Dual Accountability and the Nationalization of Party Competition: Evidence from Four Federations, 2011, *Party Politics* 17, 5: 629-653 (with Erik Wibbels).

The Geographic Distribution of Political Preferences, 2010, *Annual Review of Political Science* 13: 297-340.

Fiscal Decentralization and the Business Cycle: An Empirical Study of Seven Federations, 2009, *Economics and Politics* 22,1: 37-67 (with Erik Wibbels).

Getting into the Game: Legislative Bargaining, Distributive Politics, and EU Enlargement, 2009, *Public Finance and Management* 9, 4 (with Deniz Aksoy).

The Strength of Issues: Using Multiple Measures to Gauge Preference Stability, Ideological Constraint, and Issue Voting, 2008. *American Political Science Review* 102, 2: 215-232 (with Stephen Ansolabehere and James Snyder).

Does Religion Distract the Poor? Income and Issue Voting Around the World, 2008, *Comparative Political Studies* 41, 4: 437-476 (with Ana Lorena De La O).

Purple America, 2006, *Journal of Economic Perspectives* 20,2 (Spring): 97-118 (with Stephen Ansolabehere and James Snyder).

Economic Geography and Economic Voting: Evidence from the U.S. States, 2006, *British Journal of Political Science* 36, 3: 527-47 (with Michael Ebeid).

Distributive Politics in a Federation: Electoral Strategies, Legislative Bargaining, and Government Coalitions, 2004, *Dados* 47, 3 (with Marta Arretche, in Portuguese).

Comparative Federalism and Decentralization: On Meaning and Measurement, 2004, *Comparative Politics* 36, 4: 481-500. (Portuguese version, 2005, in *Revista de Sociologia e Política* 25).

Reviving Leviathan: Fiscal Federalism and the Growth of Government, 2003, *International Organization* 57 (Fall), 695-729.

Beyond the Fiction of Federalism: Macroeconomic Management in Multi-tiered Systems, 2003, *World Politics* 54, 4 (July): 494-531 (with Erik Wibbels).

The Dilemma of Fiscal Federalism: Grants and Fiscal Performance around the World, 2002, *American Journal of Political Science* 46(3): 670-687.

Strength in Numbers: Representation and Redistribution in the European Union, 2002, *European Union Politics* 3, 2: 151-175.

Does Federalism Preserve Markets? *Virginia Law Review* 83, 7 (with Susan Rose-Ackerman). Spanish version, 1999, in *Quorum* 68.

Working Papers

Elections, Political Polarization, and Economic Uncertainty, NBER Working Paper 27961 (with Scott Baker, Aniket Baksy, Nicholas Bloom, and Steven Davis).

Federalism and Inter-regional Redistribution, Working Paper 2009/3, Institut d'Economia de Barcelona.

Representation and Regional Redistribution in Federations, Working Paper 2010/16, Institut d'Economia de Barcelona (with Tiberiu Dragu).

Chapters in Books

Political Geography and Representation: A Case Study of Districting in Pennsylvania (with Thomas Weighill), in *Political Geometry*, edited by Moon Duchin and Olivia Walch, forthcoming 2021, Springer.

Keeping Your Enemies Close: Electoral Rules and Partisan Polarization, in *The New Politics of Insecurity*, edited by Frances Rosenbluth and Margaret Weir, forthcoming 2021, Cambridge University Press.

Decentralized Rule and Revenue, 2019, in Jonathan Rodden and Erik Wibbels, eds., *Decentralized Governance and Accountability*, Cambridge University Press.

Geography and Gridlock in the United States, 2014, in Nathaniel Persily, ed. *Solutions to Political Polarization in America*, Cambridge University Press.

Can Market Discipline Survive in the U.S. Federation?, 2013, in Daniel Nadler and Paul Peterson, eds., *The Global Debt Crisis: Haunting U.S. and European Federalism*, Brookings Press.

Market Discipline and U.S. Federalism, 2012, in Peter Conti-Brown and David A. Skeel, Jr., eds., *When States Go Broke: The Origins, Context, and Solutions for the American States in Fiscal Crisis*, Cambridge University Press.

Federalism and Inter-Regional Redistribution, 2010, in Nuria Bosch, Marta Espasa, and Albert Sole Olle, eds., *The Political Economy of Inter-Regional Fiscal Flows*, Edward Elgar.

Back to the Future: Endogenous Institutions and Comparative Politics, 2009, in Mark Lichbach and Alan Zuckerman, eds., *Comparative Politics: Rationality, Culture, and Structure* (Second Edition), Cambridge University Press.

The Political Economy of Federalism, 2006, in Barry Weingast and Donald Wittman, eds., *Oxford Handbook of Political Economy*, Oxford University Press.

Fiscal Discipline in Federations: Germany and the EMU, 2006, in Peter Wiers, Servaas Deroose, Elena Flores and Alessandro Turrini, eds., *Fiscal Policy Surveillance in Europe*, Palgrave MacMillan.

The Political Economy of Pro-cyclical Decentralised Finance (with Erik Wibbels), 2006, in Peter Wiers, Servaas Deroose, Elena Flores and Alessandro Turrini, eds., *Fiscal Policy Surveillance in Europe*, Palgrave MacMillan.

Globalization and Fiscal Decentralization, (with Geoffrey Garrett), 2003, in Miles Kahler and David Lake, eds., *Governance in a Global Economy: Political Authority in Transition*, Princeton University Press: 87-109. (Updated version, 2007, in David Cameron, Gustav Ranis, and Annalisa Zinn, eds., *Globalization and Self-Determination: Is the Nation-State under Siege?* Routledge.)

Introduction and Overview (Chapter 1), 2003, in Rodden et al., *Fiscal Decentralization and the Challenge of Hard Budget Constraints* (see above).

Soft Budget Constraints and German Federalism (Chapter 5), 2003, in Rodden, et al, *Fiscal Decentralization and the Challenge of Hard Budget Constraints* (see above).

Federalism and Bailouts in Brazil (Chapter 7), 2003, in Rodden, et al., *Fiscal Decentralization and the Challenge of Hard Budget Constraints* (see above).

Lessons and Conclusions (Chapter 13), 2003, in Rodden, et al., *Fiscal Decentralization and the Challenge of Hard Budget Constraints* (see above).

Online Interactive Visualization

Stanford Election Atlas, 2012 (collaboration with Stephen Ansolabehere at Harvard and Jim Herries at ESRI)

Other Publications

Supporting Advanced Manufacturing in Alabama, Report to the Alabama Innovation Commission, Hoover Institution, 2021.

How America's Urban-Rural Divide has Shaped the Pandemic, 2020, *Foreign Affairs*, April 20, 2020.

An Evolutionary Path for the European Monetary Fund? A Comparative Perspective, 2017, Briefing paper for the Economic and Financial Affairs Committee of the European Parliament.

Representation and Regional Redistribution in Federations: A Research Report, 2009, in *World Report on Fiscal Federalism*, Institut d'Economia de Barcelona.

On the Migration of Fiscal Sovereignty, 2004, *PS: Political Science and Politics* July, 2004: 427-431.

Decentralization and the Challenge of Hard Budget Constraints, *PREM Note* 41, Poverty Reduction and Economic Management Unit, World Bank, Washington, D.C. (July).

Decentralization and Hard Budget Constraints, *APSA-CP* (Newsletter of the Organized Section in Comparative Politics, American Political Science Association) 11:1 (with Jennie Litvack).

Book Review of *The Government of Money* by Peter Johnson, *Comparative Political Studies* 32,7: 897-900.

Fellowships, Honors, and Grants

John Simon Guggenheim Memorial Foundation Fellowship, 2021.

Martha Derthick Award of the American Political Science Association for "the best book published at least ten years ago that has made a lasting contribution to the study of federalism and intergovernmental relations," 2021.

National Institutes of Health, funding for "Relationship between lawful handgun ownership and risk of homicide victimization in the home," 2021.

National Collaborative on Gun Violence Research, funding for "Cohort Study Of Firearm-Related Mortality Among Cohabitants Of Handgun Owners." 2020.

Fund for a Safer Future, Longitudinal Study of Handgun Ownership and Transfer (LongSHOT), GA004696, 2017-2018.

Stanford Institute for Innovation in Developing Economies, Innovation and Entrepreneurship research grant, 2015.

Michael Wallerstein Award for best paper in political economy, American Political Science Association, 2016.

Common Cause Gerrymandering Standard Writing Competition, 2015.

General support grant from the Hewlett Foundation for Spatial Social Science Lab, 2014.

Fellow, Institute for Research in the Social Sciences, Stanford University, 2012.

Sloan Foundation, grant for assembly of geo-referenced precinct-level electoral data set (with Stephen Ansolabehere and James Snyder), 2009-2011.

Hoagland Award Fund for Innovations in Undergraduate Teaching, Stanford University, 2009.

W. Glenn Campbell and Rita Ricardo-Campbell National Fellow, Hoover Institution, Stanford University, beginning Fall 2010.

Research Grant on Fiscal Federalism, Institut d'Economia de Barcelona, 2009.

Fellow, Institute for Research in the Social Sciences, Stanford University, 2008.

United Postal Service Foundation grant for study of the spatial distribution of income in cities, 2008.

Gregory Luebbert Award for Best Book in Comparative Politics, 2007.

Fellow, Center for Advanced Study in the Behavioral Sciences, 2006-2007.

National Science Foundation grant for assembly of cross-national provincial-level dataset on elections, public finance, and government composition, 2003-2004 (with Erik Wibbels).

MIT Dean's Fund and School of Humanities, Arts, and Social Sciences Research Funds.

Funding from DAAD (German Academic Exchange Service), MIT, and Harvard EU Center to organize the conference, "European Fiscal Federalism in Comparative Perspective," held at Harvard University, November 4, 2000.

Canadian Studies Fellowship (Canadian Federal Government), 1996-1997.

Prize Teaching Fellowship, Yale University, 1998-1999.

Fulbright Grant, University of Leipzig, Germany, 1993-1994.

Michigan Association of Governing Boards Award, one of two top graduating students at the University of Michigan, 1993.

W. J. Bryan Prize, top graduating senior in political science department at the University of Michigan, 1993.

Other Professional Activities

Selection committee, best paper award, American Journal of Political Science.

International Advisory Committee, Center for Metropolitan Studies, Sao Paulo, Brazil, 2006-2010.

Selection committee, Mancur Olson Prize awarded by the American Political Science Association Political Economy Section for the best dissertation in the field of political economy.

Selection committee, Gregory Luebbert Best Book Award.

Selection committee, William Anderson Prize, awarded by the American Political Science Association for the best dissertation in the field of federalism and intergovernmental relations.

Courses

Undergraduate

Politics, Economics, and Democracy
Introduction to Comparative Politics
Introduction to Political Science
Political Science Scope and Methods
Institutional Economics
Spatial Approaches to Social Science

Graduate

Political Economy
Political Economy of Institutions
Federalism and Fiscal Decentralization
Politics and Geography

Consulting

2017. Economic and Financial Affairs Committee of the European Parliament.
2016. Briefing paper for the World Bank on fiscal federalism in Brazil.
2013-2018: Principal Investigator, SMS for Better Governance (a collaborative project involving USAID, Social Impact, and UNICEF in Arua, Uganda).
2019: Written expert testimony in *McLemore, Holmes, Robinson, and Woullard v. Hosemann*, United States District Court, Mississippi.
2019: Expert witness in *Nancy Corola Jacobson v. Detzner*, United States District Court, Florida.
2018: Written expert testimony in *League of Women Voters of Florida v. Detzner* No. 4:18-cv-002510, United States District Court, Florida.
2018: Written expert testimony in *College Democrats of the University of Michigan, et al. v. Johnson, et al.*, United States District Court for the Eastern District of Michigan.
2017: Expert witness in *Bethune-Hill v. Virginia Board of Elections*, No. 3:14-CV-00852, United States District Court for the Eastern District of Virginia.
2017: Expert witness in *Arizona Democratic Party, et al. v. Reagan, et al.*, No. 2:16-CV-01065, United States District Court for Arizona.
2016: Expert witness in *Lee v. Virginia Board of Elections*, 3:15-cv-357, United States District Court for the Eastern District of Virginia, Richmond Division.
2016: Expert witness in *Missouri NAACP v. Ferguson-Florissant School District*, United States District Court for the Eastern District of Missouri, Eastern Division.

2014-2015: Written expert testimony in *League of Women Voters of Florida et al. v. Detzner, et al.*, 2012-CA-002842 in Florida Circuit Court, Leon County (Florida Senate redistricting case).

2013-2014: Expert witness in *Romo v Detzner*, 2012-CA-000412 in Florida Circuit Court, Leon County (Florida Congressional redistricting case).

2011-2014: Consultation with investment groups and hedge funds on European debt crisis.

2011-2014: Lead Outcome Expert, Democracy and Governance, USAID and Social Impact.

2010: USAID, Review of USAID analysis of decentralization in Africa.

2006-2009: World Bank, Independent Evaluations Group. Undertook evaluations of World Bank decentralization and safety net programs.

2008-2011: International Monetary Fund Institute. Designed and taught course on fiscal federalism.

1998-2003: World Bank, Poverty Reduction and Economic Management Unit. Consultant for *World Development Report*, lecturer for training courses, participant in working group for assembly of decentralization data, director of multi-country study of fiscal discipline in decentralized countries, collaborator on review of subnational adjustment lending.

Last updated: September 23, 2021

Exhibit 2

